

PRICE, \$1.00.
PRICE OF VOL. I., \$1.25.

COLUMBIAN MUSEUM

P
Biol
W

JOURNAL

Biological
& Medical
Serials

New Jersey Natural
History

The Trenton Natural History Society.

Vol 1, No. 3.

JANUARY, 1888.

CONTENTS.

Fresh-Water Infusoria. <i>Dr. Alfred C. Stokes</i>	71
Notes on the Flora of Bergen County, N. J. <i>Willard A. Stowell</i>	345
Notes on an Intelligent Parrot. <i>Dr. T. S. Stevens</i>	347
Do Snakes Charm? <i>F. A. Lucas</i>	356
Errata.....	359
Members, Correspondents and Contributors.....	360
Index to Vol. I.	361

TRENTON, N. J.:
PUBLISHED BY THE SOCIETY.

1888.

State Gazette Print.



PRICE, \$1.00.
PRICE OF VOL. I., \$1.25.

COLONIAL MUSEUM

P
Biol
W

JOURNAL

Biological
& Medical
Serials

New Jersey Natural
History

The Trenton Natural History Society.

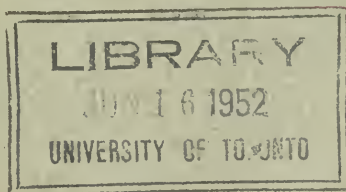
Vol 1, No. 3.

JANUARY, 1888.

CONTENTS.

Fresh-Water Infusoria. <i>Dr. Alfred C. Stokes</i>	71
Notes on the Flora of Bergen County, N. J. <i>Willard A. Stowell</i>	345
Notes on an Intelligent Parrot. <i>Dr. T. S. Stevens</i>	347
Do Snakes Charm? <i>F. A. Lucas</i>	356
Eriata.....	359
Members, Correspondents and Contributors.....	360
Index to Vol. I.	361

TRENTON, N. J.:
PUBLISHED BY THE SOCIETY.
1888.



OFFICERS FOR 1888-9.

PRESIDENT,

DR. T. S. STEVENS.

TREASURER,

PROF. AUSTIN C. APGAR.

SECRETARY,

FRED. A. LUCAS.

CORRESPONDING SECRETARY,

PROF O. P. STEVES.

LIBRARIAN,

GEORGE PINE

NOTE.— Please acknowledge the receipt of this paper to the Society at Trenton,
New Jersey, U. S. A. Publications of other Societies desired in exchange.

New Jersey Natural
History Society

JOURNAL
OF THE
TRENTON NATURAL HISTORY SOCIETY.

VOL. I.

JANUARY, 1888.

No. 3.

A PRELIMINARY CONTRIBUTION TOWARD A HISTORY OF
THE FRESH-WATER INFUSORIA OF THE
UNITED STATES.

BY ALFRED C. STOKES, M.D.

The following is a list of the fresh-water Infusoria thus far identified or discovered in this country. Those forms identical with European species are, for the most part, recorded by name only, American genera and species being more fully characterized.

The classification is chiefly Bütschli's,* so far as that scheme has been published at this writing.

SUB-KINGDOM PROTOZOA.

SECTION INFUSORIA.

CLASS FLAGELLATA, *Ehr.*

ORDER MONADIDEA, *Bütschli.*

*Bronn's *Classen und Ordnungen des Thierreichs. Protozoa.*

*Family RHIZOMASTIGIDÆ, Bütschli.**Genus MASTIGAMCEBA, Schulze.**MASTIGAMCEBA LONGIFILUM, Stokes. Pl. I, figs. 1, 2, 3 and 4.**Mastigamceba longifilum.* Stokes: Proc. Am. Philos. Soc. xxiii, No. 124, 1886.

Animalcules repent, very soft and extremely changeable in shape, emitting from all parts of the surface simple lobate pseudopodia, or wave-like expansions of the sarcode; the single antero-terminal flagellum five times as long as the contracted body, about twice as long as the extended zoöid; contractile vesicle single, anteriorly placed; nucleus subspherical, small, situated near the anterior extremity. Length, when contracted, $\frac{1}{2250}$ inch; extended, $\frac{1}{900}$ inch. Habitat.—Standing water, among decaying vegetation.

The figures show four forms of the same interesting little amœboid creature. The movements are usually slowly repent, while the flagellum is quite active. The zoöid not rarely glides forward without the protrusion of distinct pseudopodia, only changing the form of the body by irregular expansions and contractions, while on other occasions the unbranched obtuse pseudopodia extend from any or all points of the periphery.

*MASTIGAMCEBA SIMPLEX, S. K.**Genus REPTOMONAS, S. K.**REPTOMONAS CAUDATA, S. K.**Genus ACTINOMONAS, S. K.**ACTINOMONAS VERNALIS, Stokes. Pl. I, fig. 5.**Actinomonas vernalis.* Stokes: Am. Monthly Micros. Jour., vi, July, 1885.

Body subspherical, the frontal border slightly emarginate, somewhat changeable in shape, free-swimming or temporarily attached by a short pedicle; flagellum entirely vibratile, equalling or somewhat exceeding the diameter of the body in length; endoplasm transparent, slightly granular; pseudopodia few in

number, radiating from any part of the periphery, simple or variously branched, often capitate, sometimes curved, their length exceeding the diameter of the body; contractile vesicles several, small, distributed near the periphery; nucleus spherical, subcentral. Diameter of body $\frac{1}{1200}$ to $\frac{1}{1500}$ inch. Habitat.—Shallow ponds, in early spring.

This remarkable combination of rhizopod and infusorian was abundant in the first gathering made in early spring from a shallow little pool near a country wayside. Green Algæ were already a conspicuous feature of the surface, and their flagellate spores quite as conspicuous constituents of the water when in the field of the microscope. On these active germs the *Actinomonas* was so greedily feeding that its endoplasm was usually crowded and colored by them. In this matter of taking food it has decidedly the advantage of its relatives higher in the scale of life, since the act can be performed in either the sedentary or the freely motile condition. In the former the pseudopodia are entirely withdrawn, and food is then engulfed at any point on the surface, being taken with a large drop of water, as is commonly done by so many of the mouthless forms.

The movements in the rayless state are comparatively slow and irregular, consisting of a revolution on the longitudinal axis, with sudden changes of position, and with a frequent, rapid, but not long-continued trembling or shivering of the entire body, very little space being traversed by its efforts, the motions not being those of the gigantic *Monas* which the infusorian then closely resembles. When in this monadiform condition it is easily recognized as a member of the genus *Actinomonas* by this peculiar and characteristic shivering. When quietly seated at the extremity of the short temporarily developed pedicle, the flagellum dashes the food-particles into contact with the pseudopodia, which then draw it into the body, a performance characteristic of the genus.

The pseudopodia themselves are usually simple and often tipped by a minute spherule of protoplasm, with one or more

protoplasmic enlargements in the course of the ray, and a frequent thickening at any point by a flow of sarcode, after the manner of the Rhizopoda. The branching, in the individuals observed, was at times a simple bifurcation, occasionally becoming compound, as shown in the figure.

The small contractile vesicles are scattered near the periphery, their exact number being difficult to determine on account of their irregular distribution and apparently different distances from the surface under examination. At least six can be detected, two placed near the frontal border, two on the opposite side near the equator, and two in the posterior part of the body. This large number would be sufficient to distinguish the creature from the previously observed species, all of which are marine, did not the branching pseudopodia serve the purpose better, as this habit has not been noticed in the salt-water forms.

The thread-like pedicle seems to be but seldom protruded unless, in the instances in which I have failed to observe it, the infusorian has been in such a position that the body has obscured it. Two or more of the pseudopodia appear to serve as anchoring attachments, the capitate tips being applied to an algal or other filament. This habit has also been noticed in *A. pusilla*, S. K.

Genus ACINETACTIS, Stokes.

Animalcules subspherical, soft and changeable in form, free-swimming or temporarily adherent, emitting from all parts of the surface capitate ray-like pseudopodia; flagella two, subequal, vibratile, one temporarily adherent by its distal extremity. Inhabiting fresh water.

The single member of this genus differs from the *Actinomonas* of Saville Kent in the presence of two flagella, and in the distinctly capitate character of the filamentous pseudopodia, the latter often being conspicuously pin-like in appearance.

ACINETACTIS MIRABILIS, Stokes. Pl. I, fig. 6.

Acinetactis mirabilis. Stokes: Proc. Am. Phil. Soc., xxiii, No. 124, 1886.

Body subspherical, soft and plastic, often emitting short, lobate pseudopodia in addition to the fine, capitate rays projecting from all parts of the periphery, the last-named appendages usually bearing one or more minute supplementary protoplasmic globules in the course of the ray, in addition to the globule tipping the free extremity; rays occasionally exceeding the diameter of the body in length; flagella subequal, their length about twice the diameter of the zoöid, originating from the anterior border, but at some distance from each other; contractile vesicle double, situated on opposite sides of the anterior body-half; nucleus apparently subcentrally located and subspherical; endoplasm granular, especially posteriorly. Diameter of the body $\frac{1}{2250}$ inch. Habitat.—Stagnant pond-water, among decaying vegetation. Movements rapid.

When in the free-swimming phase, the ray-like pseudopodia are usually confined to the posterior region of the body, or they may be entirely withdrawn, thus leaving the animalcule almost entirely smooth.

Family CERCOMONADIDÆ, S. K.

Genus OIKOMONAS, S. K.

OIKOMONAS MUTABILIS, S. K.

OIKOMONAS TERMO (*J.-Clk.*), S. K.

Family BIKÆCIDÆ, Stein.

Genus BICOSÆCA, *J.-Clk.*

BICOSÆCA LACUSTRIS, *J.-Clk.*

BICOSÆCA LEPTÆCA, Stokes. Pl. I, fig. 7.

Bicosœca leptœca. Stokes: Am. Jour. Sci., xxix, April, 1885.

Lorica subcylindrical, three times as long as broad, truncate and slightly narrowed anteriorly into an inconspicuous neck, somewhat inflated centrally, thence gradually tapering to the

acute point of attachment to the pedicle whose length equals the greatest width of the lorica; animalcule ovate, with the usual oblique frontal border, the two diverse flagella and the eccentrically attached contractile ligament; the extended body projecting but a short distance beyond the lorica; pulsating vesicles two; nucleus sub-centrally situated. Length of lorica $\frac{1}{1500}$ to $\frac{1}{1800}$ inch. Habitat.—Pond-water; with *Myriophyllum* and Algae.

This minute creature is among the largest of the genus. The loricae change from the hyaline condition of youth to a semi-opaque chestnut-brown coloration of maturity and old age; and occasionally a deserted lorica is observed which, judging from this change of tint, is neither youthful nor mature, for the posterior half has assumed a translucent chestnut hue while the remaining portion is as colorless as when first secreted. Reasoning from this alteration, it is probable that the chemical composition of these protective sheaths is similar to that of the Vaginicolina and to some of the pedicles of the Choano-Flagellata, in all of which the change of coloration has been observed.

The present form has been frequently noticed attached to the loricae of *Stylobryon Abbotti*, Stokes, where it may cause some surprise to one who has not previously met the very dissimilar animalcules in separate localities. The *Bicosæca* adapts itself to the situation by a curvature of the pedicle, so as to better profit by the stronger and more abundantly food-laden currents produced by the host.

BICOSÆCA LEPTOSTOMA, Stokes. Pl. I, fig. 8.

Bicosæca leptostoma. Stokes: Am. Jour. Sci., xxix, April, 1885.

Lorica elongate-ovate or subfusiform, three times as long as broad, tapering anteriorly to a short, neck-like portion, the aperture very narrow, the margin not everted; the posterior half tapering to the pedicle whose length equals one-half of the greatest width of the lorica; animalcule ovate or subpyriform,

occupying the anterior half of the sheath, being entirely enclosed, with the exception of the long, lip-like projection extending beyond the aperture; contractile vesicles two, posteriorly placed; nucleus anteriorly situated. Length of lorica $\frac{1}{1500}$ inch. Habitat.—Pond-water; attached to *Myriophyllum* and Algæ. Gregarious.

This form most closely resembles the salt-water *B. tenuis*, S. K., and may be considered its fresh-water representative, resembling it also in the proportion borne by the length of the lorica to its width, and in the short distance to which the extended zoöid protrudes itself, but conspicuously differing in size, length of pedicle, and in the form of the enclosed animalcule. The narrow lip-like prominence being the only portion which projects beyond the lorica, it receives and accepts, or rejects, all food particles thrown upon it by the flagella. It is usually held arcuately curved, unwelcome particles commonly traversing its concavity to escape, as though urged by a strong current, acceptable matters being engulfed by an advancing wave of sarcode.

BICOSCECA ACUMINATA, Stokes. Pl. I, fig. 9.

Bicosceca acuminata. Stokes: Am. Monthly Micros. Jour., vi, July, 1885.

Lorica irregularly ovate, less than twice as long as broad, slightly narrowed anteriorly, the border truncate, the posterior two-thirds rapidly tapering to a pedicle two or three times its height; enclosed animalcule subspherical, filling the anterior part of the lorica and projecting beyond the anterior border; contractile vesicle double, the two placed side by side near the centre of one lateral border; nucleus subcentral. Length of lorica $\frac{1}{3000}$ inch; of enclosed zoöid $\frac{1}{4500}$ inch. Habitat.—On *Utricularia* from the New Jersey pine barrens. Solitary or scattered. Reproduction by transverse fission.

This minute form seems very bold, sitting at the aperture of the lorica and exposing a considerable part of the body almost continuously, the contractile ligament rarely drawing it to the

rear of the sheath. It is also noteworthy in respect to the position of the contractile vesicles, these in other species being usually posteriorly located, often postero-terminal. Reproduction is accomplished quite rapidly, the body elongating and dividing transversely, having previously extruded one, probably two, additional flagella. The newly-formed long flagellum is very apparent, the smaller being so excessively minute that its existence could not be positively determined.

The lorica is very delicate. It will not even for a short time resist the action of a solution of caustic potassa, which was applied for the destruction of the enclosed zoöid so that the exact form of the sheath could be seen, but which dissolved the lorica almost as soon as the softer body within. This is somewhat unusual, the lorice commonly withstanding even prolonged exposure to the caustic solution.

BICOSCECA DISSIMILIS, Stokes. Pl. I, fig. 10.

Bicosceca dissimilis. Stokes: Am. Monthly Micros. Jour., vi, July, 1855.

Lorica elongate-ovate, two and one-half times as long as broad, slightly narrowed anteriorly and there forming an inconspicuous, neck-like prolongation, the border truncate, not everted; supported posteriorly on a pedicle nearly equalling it in height; enclosed body subspherical, situated near the centre of the lorica, not in contact with the walls when extended, nor projecting beyond the frontal border; contractile ligament about one-half as long as the lorica; nucleus spherical, subcentral; contractile vesicle double, postero-terminal. Length of lorica $\frac{1}{900}$ inch; diameter of enclosed animalcule $\frac{1}{3400}$ inch. Habitat.—On *Utricularia* from the pine barrens of New Jersey. Solitary.

There is a remarkable disparity between the size of the infusorian's body and that of the sheath formed for its protection. It is a pigmy in a giant's castle, and it seems a timid creature. Safely surrounded by its transparent walls, it remains near the centre of the single apartment even when the retractile ligament

has extended to its greatest length, never passing the anterior opening, never exposing itself to any current except that made by the lashing of its own flagella, the body freely floating at the extremity of the restraining thread. The lip is short and inconspicuous, and the frontal excavation shallow. The long flagellum is very long, and seems to vibrate throughout its entire length; it at least does not present the aspect of a lash curved and vibrating at the distal extremity only, as in most of the forms hitherto discovered. The lorica also is the largest yet noted in any member of the genus, while the enclosed zoöid is among the smallest.

BICOSCECA LONGIPES, Stokes. Pl. I, fig. 11.

Bicosceca longipes. Stokes: Am. Jour. Sci., xxix, April, 1885.

Lorica ovate, twice as long as broad, slightly narrowed anteriorly, the margin not everted, tapering towards the junction with the pedicle, which is four or five times as long as the lorica; enclosed animalcule subspherical, extending but a short distance beyond the aperture; contractile vesicles two, posteriorly situated. Length of lorica $\frac{1}{2\frac{1}{2}0}$ inch. Habitat.—Pond-water; attached to *Myriophyllum*. Solitary.

Genus *STYLOBRYON*, From.

STYLOBRYON ABBOTTI, Stokes. Pl. I, fig. 12.

Stylobryon Abbotti. Stokes: Am. Jour. Sci., xxix, April, 1885.

Loricæ conical-campanulate, widest anteriorly, not everted, tapering without constriction to the pedicle, twice as long as broad, and united to each other by secondary foot-stalks about one-half the length of a single lorica, into the cavity of each of which they are continued along the lateral wall, becoming gradually attenuated to the extremity, each lorica usually bearing two loricæ which are apparently sessile on the antero-lateral borders of their supporting sheath; primary foot-stalk about six times as long as a single lorica; enclosed animalcule not con-

spicuously changeable in shape, ovate or subspherical, the projecting lip short; flagella two, the longer scarcely projecting beyond the orifice of the lorica, to the posterior region of which the zoöid is confined by a short, filamentous, contractile ligament; pulsating vesicle single, posteriorly placed; nucleus subcentral. Length of individual lorice $\frac{1}{1500}$ inch. Habitat.—Pond-water; attached to filamentous Algæ or other fine vegetable fibres.

The polythecium, unlike that of *Stylobryon petiolatum* (Duj.), S. K., which it most resembles, is subject to but little variation in its mode of colony-building. As shown in the figure, from which most of the enclosed zoöids have been intentionally omitted, its usual method is to erect a cluster of tapering, bell-shaped lorice by attaching two to the frontal borders of the primary sheath and continuing in the same manner until the polythecium is completed. Occasionally, however, the first or supporting lorica bears three, the third being centrally placed, but, so far as observed, not further continuing this tripartite arrangement. The number of lorice composing the polythecium takes a considerable range with age. No colonies have as yet been noted with less than six, neither has it thus far been the writer's good fortune to obtain one of these beautiful polythecia exhibiting more than the thirty-one which composed the colony shown in the figure.

The lorice, like those of many other sheath-dwelling Infusoria, are remarkable for the great apparent facility with which they change their hyaline condition to a translucent but deep chestnut-brown coloration. As in *Bicosauca lepteca*, this is occasionally accomplished so early that in some polythecia, although the terminal lorice have seemed to be incompletely formed, yet their posterior portions have become brown while the remainder, apparently in process of secretion, has been colorless and transparent.

In general appearance this species resembles *Stylobryon petiolatum*, differing in being less variable in the manner of building up its polythecium, in the shape and posterior position of the

enclosed animalcules, in the more conical outline of the component loriceæ, and especially in the much smaller size of the latter, those of *S. petiolatum* measuring from $\frac{1}{500}$ to $\frac{1}{800}$ inch, while with the present species none greater than $\frac{1}{1500}$ inch have been observed.

STYLOBYRON PETIOLATUM (*Duj.*), *S. K.*

Family HETEROMONADIDÆ, *Bütschli.*

Genus PHYSONOMAS, *S. K.*

PHYSONOMAS ELONGATA, *Stokes.* Pl. I, figs. 13 and 14.

Physomonas elongata. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Body elongate-ovate, somewhat changeable in shape, twice as long as broad, often widest posteriorly, and somewhat curved toward one side anteriorly; free-swimming, or temporarily attached by a short, inconspicuous, posteriorly developed pedicle; frontal border obliquely truncate, the lip usually prominent; primary flagellum subequal to the body in length, the secondary one about one-third that length; contractile vesicle single, small, spherical, situated in the anterior body-half near the lateral border; endoplasm colorless, slightly granular. Length of body $\frac{1}{2250}$ inch. Habitat.—Swamp-water with decaying vegetation, from South Florida.

This conspicuously differs from the previously recorded forms in the absence of the subspherical contour commonly considered characteristic of the genus. The very short, temporarily developed pedicle is another well-marked point of divergence between this and the other two species. Frequently no distinct pedicle can be discerned, the attachment appearing to be accomplished by a slight extension and conspicuous acumination of the posterior extremity.

Reproduction takes place by longitudinal fission, the smaller, more nearly spherical, resultant zooids being abundant in the same infusion with the larger, ovate individuals. The contractile vesicle is placed on one side near that part of the frontal

border opposite to the lip-like projection. Its movements are quick and snapping.

· *PHYSOMONAS VESTITA*, *Stokes*. Pl. I, fig. 15.

Physomonas vestita. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body subglobose, the anterior truncation obsolete; the entire surface clothed with a delicate, mucilaginous, finely granular investment, through which penetrate numerous fine, flexible, ray-like bodies apparently originating from all points of the cuticular surface; long flagellum twice the diameter of the body in length, the distal extremity arcuately curved, the secondary appendage one-fourth that length, vibratile; endoplasm granular; pedicle filiform, flexible, four times the diameter of the body in length; contractile vesicles two, situated close to and slightly in advance of the median line; a linear, somewhat curved band or groove near the frontal body-margin. Diameter of the body $\frac{1}{1666}$ inch. Habitat.—Pond-water, with *Myriophyllum*. Solitary.

In two particulars this species differs from the hitherto single known member of the genus: in the absence of the truncated anterior border, and in the presence of a linear, dark-bordered band or depression near the frontal margin, as exists in *Spumella*. In structure, habits and other characters it is a *Physomonas*.

The radiating filiform bodies which project from all parts of the surface possess some of the characters of what Dr. Joseph Leidy, in his monograph on the fresh-water rhizopods of North America, has styled "cils," being, in this instance, permanent, non-vibratile, hair-like prolongations. These filaments have no circulation of their substance as do true pseudopodia emitted by the rhizopods and some of the lowest of the Infusoria; they are not retractile, neither do they take any active part in the capture of food as in some of the rhizopodous Infusoria, where the nutritive particles, dashed down by the flagellum, adhere to one or more of the pseudopodic extensions and are drawn into

the body. With the present species the food, thrown down by the action of the short flagellum, enters at any part of the surface, usually, however, near the base of the flagella, where the surface opens, the mucilaginous investment and the radiating filaments moving outwardly on what appears to be a delicate cuticle, a wave-like outflow of the endoplasm surrounds the particle and draws it into the body, enclosed in a large drop of water. In length these ray-like cuticular appendages are little shorter than the short flagellum.

The nucleus is indistinct. It is presumably located centrally, although it has not been positively identified.

PHYSOMONAS SOCIALIS, *S. K.*

Genus CLADONEMA, *S. K.*

CLADONEMA LAXA, *S. K.*

Genus DENDROMONAS, *Stein.*

DENDROMONAS VIRGARIA, (*Weisse*) *Stein.*

Genus GONIOMONAS, *Stein.*

GONIOMONAS TRUNCATA, (*Fres.*) *Stein.*

Genus CEPHALOTHAMNIUM, *Stein.*

CEPHALOTHAMNIUM CESPITOSUM, *S. K.*

Genus ANTHOPHYSA, *Bory.*

ANTHOPHYSA VEGETANS, (*Müll*) *S. K.*

ANTHOPHYSA STAGNATILIS, *Stokes*. Pl. I, figs. 16 and 17.

Anthophysa stagnatilis. *Stokes*: Am. Monthly Micros. Jour., Aug., 1887.

Bodies subpyriform, slightly compressed, about three times as long as broad, one lateral border convex, the opposite concave, the animalcule thus apparently curved toward one side; the anterior border truncate or slightly excavate, the posterior body-half tapering to the point of attachment; nucleus posteriorly located near the convex border; contractile vesicle

apparently single, placed near the centre of the same region ; endoplasm granular. Colonies social, elongate, subcylindrical, from two to four times as long as broad, composed of fifty or more zooids ; pedicle brown, soft, very flexuose, finely and somewhat irregularly striate, rarely branched, but forming extensive, inextricably-tangled, decumbent aggregations. Length of the bodies $\frac{1}{2250}$ inch ; height of a fully-developed colony about $\frac{1}{450}$ inch. Habitat.—Stagnant water, with decaying vegetation.

This interesting colonial organism differs from *A. socialis* (From.) S. K., in the form of the zooids, the number of individuals in the clusters, there being but eight in *A. socialis*, and in the lax flexuose and tangled condition of the pedicles. From *A. vegetans* it is separated by the absence of the rosette-like colonies characteristic of the former, the absence of the distinctly branching pedicle, and by the position of both the nucleus and the contractile vesicle. The last-named organs have assumed a position in *A. stagnatilis* exactly the reverse of that which obtains in *A. vegetans*, the nucleus of the latter being subcentrally placed, with two or more posteriorly located, contractile vesicles, while, in addition, the pulsating vacuole of the present species is apparently single.

The colonies, as with other forms, often leave their pedicles and swim freely by a rotary motion. In this free-swimming state the subcylindrical form frequently almost entirely disappears, the clusters becoming subspherical. This, however, is not always the case, as in some instances they become even more elongated than when attached to the foot-stalks.

Genus SPUMELLA, Cienk.

SPUMELLA GUTTULA (Ehr.), Stein.

Genus DINOBYRON, Ehr.

DINOBYRON SERTULARIA, Ehr.

Genus EPIPYXIS, Ehr.

EPIPYXIS UTRICULUS, Ehr.

ORDER EUGLENOIDEA, *Bütschli.*Family CŒLOMONADIDÆ, *Bütschli.*Genus CRYPTOGLENA, *Ehr.*CRYPTOGLENA TRUNCATA, *Stokes.* Pl. I, fig. 18.

Cryptoglana truncata. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Lorica subspherical, depressed posteriorly, the anterior border rounded, the oral aperture slightly excentric and somewhat conically projecting; the posterior margin truncate, often slightly retuse; the lower or ventral aspect gently concave, the dorsal convex; enclosed zoöid subspherical; endoplasm green; contractile vesicle double, anteriorly situated; amylaceous corpuscle single, subspherical and subcentrally located; lorica minutely punctate, colorless when young. Length $\frac{1}{1287}$ inch or less. Habitat.—Pond-water. Movements rotary on the long axis.

The enclosed body varies much in size. It is usually small, occupying but a very limited portion of the lorica anteriorly, to which it is apparently in no way attached. Among the numerous individuals examined, none have been seen with the zoöid completely filling the cavity of the sheath, and but one in which the body even approached the posterior and lateral walls.

Genus CHLOROMONAS, *S. K.*CHLOROMONAS PULCHERRIMA, *Stokes.* Pl. I, fig. 19.

Chloromonas pulcherrima, Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body subfusiform, less than six times as long as broad, the posterior region narrowed and produced as a colorless, somewhat flexible, tail-like prolongation forming about one-sixth of the entire length of the body, and sometimes slightly curved, its extremity truncate, often somewhat dilated, and usually bearing several short, fine setæ; the anterior border obtusely pointed, surrounded by three or four rows of divergent, acuminate, colorless spines, forwardly directed; the entire cuticular surface ornamented by rhombus-shaped depressions transversely placed,

largest centrally, diminishing both anteriorly and posteriorly; lateral color-bands distinct, greenish-yellow, extending through the entire length of the body, except the tail-like prolongation; flagellum shorter than the body; contractile vesicles two, situated on opposite sides of the posterior body-region; eye spot not observed. Length of body $\frac{1}{3.20}$ inch. Habitat.—Shallow pools, in early spring. Movements somewhat irregular and vacillating, not rapid.

Family EUGLENIDÆ, Stein.

Genus AMBLYOPHIS, Ehr.

AMBLYOPHIS VIRIDIS, Ehr.

Genus EUGLENA, Ehr.

EUGLENA VIRIDIS, Ehr.

EUGLENA SPIROGYRA, Ehr.

EUGLENA OXYURIS, Schmarda.

EUGLENA DESES, Ehr.

EUGLENA ACUS, Ehr.

EUGLENA TORTA, Stokes. Pl. I, fig 20.

Euglena torta. Stokes: American Naturalist, Jan., 1885.

Body elongated, subcylindrical and traversed by three longitudinal, spirally-directed furrows, or three spiral, keel-like longitudinal elevations; anterior extremity rounded and bilabiate; more or less tapering posteriorly and terminating in a colorless, acuminate, somewhat curved, caudal prolongation; cuticular surface smooth; endoplasm green; amylaceous bodies usually two, cylindrical, situated one on each side of the spherical, centrally located nucleus; contractile vesicle and pigment spot conspicuous near the anterior extremity; flagellum subequal to the body in length; movement rotary on the long axis. Length of body $\frac{1}{4.00}$ inch. Habitat.—Among *Utricularia* in shallow ponds in Western New York.

Genus CHRYSOMONAS, *Stein.*CHRYSOMONAS OCHRACEA, (*Ehr.*) *Stein.*CHRYSOMONAS PULCHRA, *Stokes.* Pl. I, figs. 21, 22 and 23.*Chrysomonas pulchra.* Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Body elongate-ovate or obovate, somewhat flexible and changeable in form, three times as long as broad, tapering and slightly constricted posteriorly, curved toward one side anteriorly, the frontal border obliquely excavate; cuticular surface entirely covered with small, hemispherical elevations; flagellum scarcely equalling the body in length; contractile vesicles two, small, spherical, situated opposite to each other near the frontal border, and contracting alternately; nucleus ovate, occasionally becoming very conspicuous. Length of body $\frac{1}{900}$ to $\frac{1}{650}$ inch. Color, green. Habitat.—Marsh-water, with *Sphagnum*.

This infusorian has the power to make conspicuous and quite rapid changes in its shape, the body at times becoming remarkably plastic; but this ability is seldom exercised to any extent greater than by the assumption of an ovoid or subspherical form.

In figures 21 and 22 are shown two forms of the body; in figure 23 the infusorian in optic longitudinal section.

Genus TRACHELOMONAS, *Ehr.*TRACHELOMONAS VOLVOCINA, *Ehr.*TRACHELOMONAS CYLINDRICA, *Ehr.*TRACHELOMONAS TORTA, *Kellicott.* Pl. I, fig. 24.*Trachelomonas torta.* Kellicott: Proc. Am. Soc. Micros., 1885.

Lorica egg-shaped, colorless, ornamented by oblique rugosities, giving it the appearance of having been twisted; aperture situated in a short, oblique groove; flagellum very long; animalcule green; contractile vesicle anteriorly situated; red eye-like pigment spot present. Length of the lorica $\frac{1}{500}$ inch. Habitat.—Pond-water, near Buffalo, N. Y. (*Kellicott.*)

TRACHELOMONAS VERRUCOSA, *Stokes*.

Trachelomonas verrucosa. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica subspherical, colorless, the entire surface covered with minute, hemispherical elevations, the anterior extremity slightly emarginate. Length and breadth $\frac{1}{1040}$ inch. Habitat.—Pond-water, with Algæ.

TRACHELOMONAS PISCATORIS, (*Fisher*) *Stokes*. Pl. I, fig. 25.

Trachelomonas piscatoris, Fisher sp. Stokes: Jour. Trenton Nat. Hist. Soc., No. 1, Jan., 1886.

Laguncula piscatoris. Fisher: Proc. Am. Soc. Micros., 1880.

Laguncula Kellicottiana. Fisher: Proc. Am. Soc. Micros., 1880.

Lorica flask-shaped, cylindrical, less than twice as long as broad, the surface clothed by numerous short, conical spines; both extremities equally rounded, the anterior aperture produced into a smooth, cylindrical, neck-like prolongation, about one-seventh the entire length of the lorica, the frontal border denticulate and often bearing a row of short, conical spines similar to those on the general surface; flagellum once and one-half to twice as long as the lorica; endoplasm usually granular; contractile vesicle and nucleus not observed. Length of lorica $\frac{1}{640}$ to $\frac{1}{1000}$ inch. Habitat.—Fresh water.

In the interesting paper noted above, Mr. Fisher states that: "On testing with solution of potash or soda * * * the spines are detached from their bases, whilst the lorica remains unaffected, either in form or rigidity. Thus the probability is established that these spines, again like those of the Echinodermata, are articulated to the lorica by an organized membrane which yields to the action of the salt, and the separation is effected. On testing with hydrochloric acid, brisk effervescence immediately takes place; the main body of the lorica is dissolved. * * * The chief constituent of the lorica is, therefore, shown to be calcareous."

TRACHELOMONAS HISPIDA, (*Perty*) *Stein.*

TRACHELOMONAS ARMATA, (*Ehr.*) *Stein.*

TRACHELOMONAS CAUDATA, (*Ehr.*) *Stein.*

TRACHELOMONAS ACANTHOSTOMA, *Stokes.*

Trachelomonas acanthostoma. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica subspherical, brown, the anterior extremity bearing two more or less irregular rows of short, conical spines encircling the orifice, which is not produced, the remaining surface punctate; endoplasm apparently vacuolar; contractile vesicle and eye-like pigment spot not observed. Length $\frac{1}{6\frac{9}{4}}$ inch. Habitat.—Pond-water.

TRACHELOMONAS URCEOLATA, *Stokes.* Pl. I, fig. 26.

Trachelomonas urceolata. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica vasiform, smooth, about twice as long as broad, the lateral margins slightly flattened, produced anteriorly in a short, subcylindrical neck, the borders somewhat everted, truncate, not oblique; posterior extremity not inflated, produced in an acuminate, tail-like prolongation; endoplasm enclosing numerous, probably amylaceous, corpuscles. Length of lorica $\frac{1}{5\frac{1}{6}\frac{3}{4}}$ inch. Habitat.—Pond-water.

Genus CYCLANURA, *Stokes.*

Animalcules free-swimming, persistent in shape, compressed, the posterior extremity evenly rounded, and never exhibiting a caudal prolongation; otherwise as in *Phacus*.

This infusorian, which is *Phacus* without the caudal prolongation, bears the same relationship to that genus as *Euglena* to *Amblyopsis*.

CYCLANURA ORBICULATA, *Stokes.* Pl. I, fig. 27.

Cyclanura orbiculata. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body ovate or suborbicular, thick, compressed, scarcely longer than broad, having an excentric, longitudinal, keel-like elevation

across the right-hand side; frontal border conspicuously emarginate; cuticular surface longitudinally striate; color grass-green; endoplasm enclosing a spherical, posteriorly located amylaceous corpuscle; contractile vesicle anteriorly placed, in close proximity with the red pigment spot. Length of body $\frac{1}{5.50}$ inch. Habitat.—Stagnant pond-water.

This rather peculiar form would seem to be foreshadowed by *Phacus acuminatus*, Stokes, in which it is only necessary to suppress the short, straight, and sharply-pointed caudal prolongation, to have essentially the infusorian here described. The latter is, however, nearly twice as large as *Ph. acuminatus*, and its body is very much thicker and stouter. It is, indeed, more robust in every particular than any previously recorded species of the genus. This peculiarity is conspicuously apparent.

Genus PHACUS, Nitzsch.

PHACUS PLEURONECTES, (Müll.) Duj.

PHACUS TRIQUETER, Ehr.

PHACUS PYRUM, (Ehr.) S. K.

PHACUS ACUMINATUS, Stokes. Pl. I, fig. 28.

Phacus acuminatus. Stokes: Am. Monthly Micros. Jour., vi, Oct., 1885.

Body depressed, broadly ovate or suborbicular, about as long as wide, one lateral border slightly concave, the other made convex by a subcentral, longitudinal keel-like elevation; cuticular surface longitudinally striate; posterior extremity rapidly tapering and produced centrally as a very short, straight, or slightly curved, acuminate tail-like prolongation; endoplasm colored green by chlorophyll corpuscles; pigment spot usually present; flagellum somewhat longer than the body. Length and greatest breadth $\frac{1}{10.00}$ inch. Habitat.—Sluggish streams, and ponds with *Myriophyllum*.

This approaches nearest *Ph. triqueter* (Ehr.), S. K., differing from it in the concave lateral surface, and the short, usually straight caudal prolongation. The presence of the distinct ovate chlorophyll corpuscles gives the endoplasm its green color, but

the discs are apparently confined to the part immediately beneath the cuticular surface, and the *Phacus* is, therefore, probably to be classed among the so-called symbiotic forms. The amylaceous corpuscles are apparently two only. They are small and seemingly subspherical. A single living active individual has been met with having the endoplasm perfectly transparent and entirely colorless. The cuticular striations are usually distinctly visible only in the dead and colorless bodies.

PHACUS LONGICAUDUS, (*Ehr.*) *Stein.*

PHACUS ANACELUS, *Stokes*. Pl. I, fig. 29.

Phacus anacelus. *Stokes*: American Naturalist, Jan., 1885.

Body broadly ovate or suborbicular, more or less compressed, the right and left sides concave, the dorsal and ventral margins each traversed by a deep longitudinal furrow, the body thus appearing to possess four keel-like ridges; caudal prolongation colorless, acuminate and curved toward the dorsal aspect of the body; eye spot and contiguous contractile vacuole conspicuous; flagellum subequal to the body in length, inserted beneath a prominent lip-like projection. Length of body $\frac{1}{600}$ inch. Habitat.—Shallow ponds in Western New York.

Genus CHLOROPELTIS, *Stein.*

CHLOROPELTIS HISPIDULA, (*Eichwald*) *Stein.*

CHLOROPELTIS MONILATA, *Stokes*. Pl. I, fig. 30.

Chloropeltis monilata. *Stokes*: Jour. Royal Micros. Soc., Feb., 1887.

Body broadly ovate or subcircular, strongly compressed, about one and one-half times as long as broad; general cuticular surface not ribbed but entirely covered with conical, rounded elevations arranged more or less in longitudinal series; caudal prolongation straight or slightly curved, forming less than one-fourth the length of the entire body; flagellum not exceeding the zoöid in length; eye-like pigment spot usually present; contractile vesicle conspicuous, anteriorly located. Length of body $\frac{1}{550}$ inch. Habitat.—Standing pond-water.

This conspicuously differs from *Ch. hispidula* (Eichwald) Stein (the only previously known species with a roughened cuticular surface), by the absence of a distinctly ribbed superficies, those longitudinal elevations in the European species being strongly hispid. In the present form the cuticular prominences are scattered over the general surface as well-marked conical monilations arising from rounded bases.

Family MENOIDIDÆ, Bütschli.

Genus MENOIDIUM, Perty.

MENOIDIUM PELLUCIDIUM, Perty.

Genus ATRACTONEMA, Stein.

ATRACONEMA TORTUOSA, Stokes. Pl. I, fig. 31.

Atractonema tortuosa. Stokes: Am. Nat., xix, May, 1885.

Body elongate, subcylindrical, soft and flexible but persistent in shape, seven to ten times as long as broad, tapering and pointed posteriorly, the anterior extremity narrowed, the frontal border truncate; oral aperture terminal, conspicuous, followed by a tubular pharyngeal passage apparently connected by its posterior termination with the spherical contractile vesicle; flagellum single, vibratile, about one-half as long as the body, issuing from the oral aperture and taking its origin from the wall of the pharynx at some distance from the frontal margin; nucleus ovate, placed behind the body-centre; endoplasm colorless, transparent, enclosing numerous, oblong, dark-bordered corpuscles; movements tortuous and rotatory on the long axis. Length of body $\frac{1}{600}$ to $\frac{1}{325}$ inch. Habitat.—A vegetable infusion.

Family MALLOMONADIDÆ, S. K.

MALLOMONAS PLOSSLI, Perty.

MALLOMONAS LITOMESA, Stokes. Pl. I, fig. 32.

Mallomonas litomesa. Stokes: Am. Monthly Micros. Jour., vi, July, 1885.

Body elongate-ovate, three times as long as broad, widest centrally, the anterior extremity narrowest, the cuticular surface

finely crenulate; the non-vibratile setose hairs confined to the two extremities, the central part of the cuticular surface entirely naked, those of the posterior extremity longest and most numerous, those about the anterior apex radiating in an almost horizontal direction; flagellum long, slender; endoplasm yellow; contractile vesicles multiple, confined to the posterior body-half; nucleus not observed. Length of body $\frac{1}{1000}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

This pretty creature is remarkable for the naked condition of the central portion of the body surface, a characteristic readily differentiating it from the other members of its genus hitherto described. This species recalls, in this respect, the Holotrichous *Cyclidium litomesum* described by the writer in the *American Monthly Microscopical Journal*, December, 1884, in which a similar arrangement of setose cilia obtains, the central cuticular surface there also being quite naked. This condition will necessitate a slight change in the diagnosis of the family and generic groups as now formulated.

The endoplasm is lemon-yellow in color, the pigmentary matter appearing to be collected in two somewhat indistinct lateral bands, the intervening pale, almost colorless, strip of sarcode filled with fine granular matter, near the centre of which is located what seems to be the nucleus, the latter, however, being very obscure. The oral aperture and the continuation as a narrow pharyngeal passage are usually distinct, the former quite conspicuously so.

Family PERANEMIDÆ, Bütschli.

Genus URCEOLUS, Meresch.

URCEOLUS CYCLOSTOMA (Stein), Meresch. Pl. I, fig. 33.

Phialonema cyclostomum, Stein. Kent: Manual of the Infusoria.

Phialonema cyclostomum, Stein. Stokes: Am. Monthly Micros. Jour., v, Aug., 1884.

Body flask-shaped, elastic and colorless, pointed posteriorly, prolonged anteriorly in a neck-like manner, the expanded oral aperture circular, truncate, and obliquely set, the rim thickened;

pharynx curved, tubular, at times extending to or beyond the centre of the body, its distal end occasionally much dilated; cuticular surface spirally striate or ridged; flagellum vibratile, retractile, often longer than the body; nucleus subcentral; contractile vesicle anteriorly placed, at one side of the pharynx. Length of body $\frac{1}{1000}$ to $\frac{1}{500}$ inch.

The American individuals seem to differ somewhat from the European representatives as described by Kent and Stein. The generic diagnosis of the infusorian from the fresh waters of Russia states that *Urceolus* is persistent in form, whereas the specimens thus far observed in this country are quite elastic and changeable. The writer has seen them suddenly and quickly contract into a semi-globose form, with the dilated and obliquely-set oral extremity almost obliterated; they are also often variously compressed and indented, and with the posterior region twisted or folded. The descriptions also say that the flagellum is short, nearly equalling the body in length. In the American specimens, however, this appendage exceeds the body-length, and is retractile. The latter accomplishment the creature seldom puts into practice; it has not been before noted. The pharynx is short, not exceeding one-fourth the length of the infusorian, and apparently does not end in a bulbous enlargement. The body is conspicuously striate, sometimes ridged, obliquely. Its movements are somewhat rapid, the large oral aperture being held in contact with the slide or supporting object, the long flagellum distinctly vibrating only at its distal extremity.

Genus URCEOLOPSIS, Stokes.

Animalcules free-swimming, flask-shaped, soft, flexible and elastic, the entire cuticular surface more or less covered by adherent, irregular and angular sand grains; otherwise essentially as in *Urceolus*.

URCEOLOPSIS SABULOSA, Stokes. Pl. I, figs. 34 and 35.

Urceolus sabulosus. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Urceolopsis sabulosa. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body flask-shaped, soft, flexible and elastic, normally compressed and somewhat gibbous, about twice as long as broad, widest centrally, obtusely pointed posteriorly, the entire surface more or less covered, often almost concealed, by adherent, irregular and angular sand grains; anterior extremity constricted to form a short, neck-like prolongation, the circular border thickened, expanded and obliquely truncate; flagellum large, equaling or exceeding the body in length; nucleus not observed; contractile vesicle (?) single, laterally placed near the anterior extremity; pharynx apparently extending to near the body-centre. Length of body $\frac{1}{500}$ inch. Habitat.—Fresh water, with Algæ.

The movements of this remarkable infusorian are usually rather rapid, resembling those of *Urceolus cyclostoma* (Stein) Meresch, (*Phialonema cyclostoma*, Stein), the obliquely truncate anterior extremity being applied to the submerged surface, and the body lifted at an acute angle, the vibrating tip of the flagellum appearing to be the only means by which an advance is made. The oral region and the entire body are very soft and elastic, but scarcely changeable in shape. The food particles and frequently small aggregations of minute fragments are drawn into the oral aperture with some force, often being quite violently dragged away from their attachment. The pharyngeal passage and nucleus were obscured by the abundance of the cuticular coating of sand grains; the former, however, appeared to reach the centre of the body.

The cuticular investment of sand grains, which is almost unique among the fresh-water Infusoria, seems to be entirely under the creature's control, so far as the amount and arrangement of the constituent particles are concerned. The process of obtaining these grains is, so far as I have observed, simply one

of adhesion. The infusorian passes above a coveted particle and it adheres to the presumably viscid surface. This is, at least, the process which takes place on the stage of the microscope, the silicious and other fragments adhering wherever they come in contact with the body surface. Their subsequent arrangement into the semblance of a protective sheath I have not been able to satisfactorily observe. It seems, however, to be accomplished by a slow movement or superficial and deliberate circulation of the ectoplasm, by means of which the grains are gradually moved into their places according to their size and shape.

For several years I have frequently met with small, ovate, actively-moving, uniflagellate organisms, the entire surface being more or less abundantly clothed with minute sand grains; and now that this remarkably interesting infusorian has been observed, to associate these little uniflagellate sand-bearers with it is an irresistible impulse; but, although the supposition of their intimate connection is plausible, it has no other than an imaginary basis. The particular organism from which figure 35 was made was $\frac{1}{1500}$ inch in length, and its load of sand was unusually large. Similar but very much smaller forms have been repeatedly observed from widely separated localities. These very small uniflagellate bodies, however, are generally the bearers of very few sand particles, which are often aggregated at the rounded summit or on one lateral border. I now suspect an intimate connection between these little creatures and the mature *Urceolopsis sabulosa*.

Family PETALOMONADIDÆ.

Genus PETALOMONAS, Stein.

PETALOMONAS DISOMATA, Stokes. Pl. I, figs. 36 and 37.

Petalomonas disomata. Stokes: Am. Monthly Micros. Jour., v, July, 1884.

Body ovate, more or less pyriform, depressed, widest and rounded posteriorly, the anterior extremity obtusely pointed, both the dorsal and ventral surfaces having a longitudinal

groove or channel extending in or near the median line from the apex to the posterior extremity ; oral aperture conspicuous ; flagellum somewhat longer than the body, directed rigidly in advance, the distal extremity only vibrating ; contractile vesicle single, in the anterior body-half near the median groove ; nucleus on the opposite side somewhat further back ; parenchyma transparent anteriorly, granular, and semi-opaque with food particles posteriorly. Length of body $\frac{1}{1000}$ inch. Habitat.—The surface of decaying leaves at the bottom of shallow ponds.

The movements of the animalcule are directly forward in a straight line, with sudden changes to the opposite direction, the flagellum being frequently held in contact with the slide or other object traversed, and the body obliquely elevated, the oral aperture thus apparently gliding over the ground in search of food, which consists chiefly of minute refractive particles, seemingly small starch granules. Occasionally the hind body has a green tinge by the inception, apparently, of chlorophyll grains ; usually, however, the animalcule is colorless.

At times the dorsal and ventral channels are indistinct, being represented by only a slight indication of a depression ; in other individuals the sulci are deep and disposed slightly on one side of the median line, thus dividing the body unequally.

In figure 36 is shown the infusorian in ventral aspect, magnified 1,000 diameters ; in figure 37 a transverse optical diagrammatic section, exhibiting the double-bodied appearance produced by the two medially disposed channels.

PETALOMONAS PLEUROSIGMA, *Stokes*. Pl. I, fig. 38.

Petalomonas pleurosigma. Stokes : Jour. Royal Micros. Soc., Feb., 1887.

Body suboval or ovate, depressed, less than twice as long as broad, widest centrally, tapering towards both extremities, the anterior margin narrowly rounded, the posterior prolonged as a short, obtuse acumination ; lateral borders more or less sigmoid ; dorsal and ventral surfaces each traversed by a narrow, sub-

central, longitudinal depression or furrow, which usually does not extend into the caudal acumination; oral fossa distinct, the flagellum apparently originating from one of its walls, and exceeding the body in length, the distal extremity alone undulating; nucleus and contractile vesicle distinct, situated opposite each other near the lateral margins of the anterior body-half. Length of body $\frac{1}{1500}$ inch. Habitat.—Standing pond-water.

In the double sulcation of the flattened surfaces, this form resembles *Petalomonas disomata*, Stokes, but is readily distinguishable by the posterior acumination, the sigmoidal lateral margins, and the smaller size.

PETALOMONAS DORSALIS, Stokes. Pl. I, fig. 39. Diagram.

Petalomonas dorsalis. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body broadly ovate or suborbicular, colorless, transparent, the length but slightly exceeding the breadth; the anterior extremity the narrower, evenly or obliquely rounded, occasionally obliquely truncate, posterior border rounded, sometimes emarginate; dorsal surface longitudinally traversed by a central, strongly compressed keel-like and upright plane, or broad wing, the superior margin of which is evenly convex; ventral surface somewhat concave, a transverse optic section of the body presenting a triradiate appearance, the re-entering, dorso-lateral and ventral angles rounded; oral fossa conspicuous, from which apparently issues a flagellum subequal to the body in length; nucleus subcircular in outline, placed near the centre of the left-hand body margin; contractile vesicle single, small, located on the left-hand side of the dorsal ala near the body centre; endoplasm coarsely granular. Length of body $\frac{1}{650}$ to $\frac{1}{600}$ inch. Habitat.—Standing pond-water.

This is readily recognizable from *P. carinata*, for which it might perhaps be mistaken, by its much larger size, and by the very conspicuously developed centro-dorsal, upright plane. In *P. carinata* the dorsal elevation is low and ridge-like, and although the lateral surfaces of this part are usually evenly

sloping or slightly convex, they are at times noticeably concave. In *P. dorsalis* the dorsal ala is usually as high as one-half the width of the body. The part seems especially liable to deformity, often being observed to be variously indented, or distorted and developed to one side or the other of its normal central position.

PETALOMONAS CARINATA, *Stokes*. Pl. I, fig. 40. Diagrams.

Petalomonas carinata. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Petalomonas carinata. Stokes: Science Gossip, Dec., 1886.

Body broadly ovate, somewhat longer than broad, both extremities rounded, the anterior the narrower; ventral surface concave, the dorsal elevated into a single, median, longitudinal, keel-like projection, traversing the entire body; flagellum not exceeding the body in length, arising apparently from the wall of the capacious oral fossa; nucleus near the centre of the right-hand margin, the contractile vesicle somewhat in advance on the opposite side; parenchyma transparent. Length of body $\frac{1}{1125}$ inch. Habitat.—Standing pond-water, with aquatic plants.

This form seems to combine the characters of *P. abscissa* (Duj.) Stein, and of *P. mediocanellata*, Stein, the former bearing one or two dorsal keel-like elevations, and the latter having a groove traversing its ventral surface, while *P. carinata* possesses both in a marked degree. The dorsal aspect of the latter is conspicuously angular, the keel-like ridge forming the apex and the right-hand and left-hand sides respectively sloping evenly in opposite directions to the lateral borders, as shown in diagrammatic transverse optic section by figure 40. The movements are usually directly forward and are not rapid, the flagellum conspicuously vibrating only at its distal extremity, the creature frequently coming to rest on a fragment of aquatic plant, and extending the flagellum in all directions, as if in search of food, or, where food seems specially abundant, remaining for a long time with the anterior border or the large oral aperture in contact with the heap of debris, the posterior extremity being lifted

upwards, the flagellum then also being directed to various points in the vicinity.

The infusorian's method of obtaining food was described by the writer in *Science Gossip* for December, 1886, from which the following is quoted :

When the *Petalomonas* finds a spot richly supplied with minute bacilli, it comes to rest. The flagellum is then thrown around to one side of the body, the base being apparently strained against the edge of the oral aperture, the entire lash, with the exception of the free extremity, being practically motionless, the distal end alone vibrating with almost rhythmical beats. The effect of these quick movements is that the bacilli are dashed against the motionless portion of the flagellum, down which they glide involuntarily to the oral fossa. Here they frequently regain their liberty, yet there is usually quite a steady flow of bacilli down the basal part of the flagellum, or across the somewhat conical posterior portion of the oral fossa, into the endoplasm. Bacilli and minute spirilla striking the curved flagellum at any part of its length are usually deflected to the oral aperture, and are sooner or later engulfed.

The posterior walls of the oral fossa are not membraneous and fixed, but soft and dilatable at the infusorian's will. There are no minute cilia nor hidden flagellum to explain the final entrance of the food particle into the endoplasm through the oral aperture proper. But the short posterior oblique plane leads to the oral orifice, and a plausible explanation of the inability of the bacillus to escape from that region may perhaps be found in the ease with which an object can move down an incline, the bacillus being assisted by its own flagella. It is also possible that this small adoral plane may be a peculiarly sensitive surface, and it may possess the power to voluntarily alter its angle of inclination so as to more readily direct the food particles to the mouth, the surface being so minute that the change of position eludes observation.

PETALOMONAS ALATA, Stokes. Pl. I, fig. 41.*Petalomonas alata*. Stokes: Jour. Royal Micros. Soc., Feb., 1887.*Paramonas alata*. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body ovate, persistent in form, about twice as long as broad, widest and rounded posteriorly; traversed longitudinally by four compressed, equidistant, somewhat obliquely directed wing-like elevations, thus exhibiting in horizontal optic section four diverging wing-like appendages or processes; oral aperture conspicuous; flagellum about twice as long as the body; endoplasm transparent, colorless. Length of body $\frac{1}{1125}$ inch. Habitat.—Pond-water, with *Ceratophyllum demersum*, L.

In figure 41 is delineated a diagrammatic horizontal optic section showing the arrangement of the alæ.

PETALOMONAS SULCATA, Stokes.*Petalomonas sulcata*. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body ovate, depressed, colorless, transparent, less than twice as long as broad, the surface traversed longitudinally or sometimes in a slightly oblique direction, by from eight to ten keel-like ridges, four to five on each surface; anterior extremity narrowly rounded; the posterior truncate, with one, sometimes two, short, subcentral acuminations apparently formed by the postero-terminal union of the longitudinal carinations; flagellum subequal to the body in length; nucleus and contractile vesicle on opposite sides of the anterior body-half; endoplasm posteriorly granular. Habitat.—Pond-water. Movements not rapid, the oral aperture usually in contact with the submerged object, the flagellum directed in advance, the distal extremity alone vibrating.

Family ASTASIIDÆ, Bütschli.

Genus ASTASIA, Ehr.

ASTASIA TRICHOPHORA, (Ehr.) Clap.

Genus HETERONEMA, Duj.

HETERONEMA ACUS, (Ehr.) Stein.

HETERONEMA GLOBURIFERUM, (Ehr.) Stein.

Genus ZYGOSELMIS, Duj.

ZYGOSELMIS MUTABILIS, Stokes. Pl. II, figs. 1, 2, 3 and 4.

Zygoselmis mutabilis. Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Normal contour of the body apparently elongate-ovate, sub-cylindrical, but extremely soft, and incessantly and most irregularly changeable in form; surface longitudinally striate; flagella two, unequal, the longer equalling the extended body in length, the shorter about one-third as long; both apparently arising from the short, conical, oral fossa; endoplasm filled with dark-bordered, colorless corpuscles of various sizes. Length of the fully extended body $\frac{1}{100}$ inch. Habitat.—Standing water from the cypress swamps of South Florida.

The incessant alterations in the form of this curious infusorian are indescribable. The metabolic movements are seemingly ceaseless, the endoplasmic corpuscles rushing from end to end of the body as it extends, contracts, twists and contorts itself. In the figures a few of these changes are shown.

The food is indiscriminately animal or vegetable. The endoplasm of the individuals observed contained desmids, diatoms, and in a single instance, a small rotifer.

ZYGOSELMIS ACUS, Stokes. Pl. II, fig. 5.

Zygoselmis acus. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body elongate, needle-shaped or subfusiform, changeable in shape, about six times as long as broad, both extremities pointed; surface smooth; endoplasm granular; flagella very diverse in length, the shorter scarcely as long as the body, the longer once and a half to twice that length; nucleus apparently subcentral. Length of body $\frac{1}{1500}$ inch. Habitat.—Standing pond-water, with aquatic plants. Movements active.

There seems to be but little dissimilarity between the *Zygo-*

selmis of Dujardin and Ehrenberg's *Distigma*, the possession by the latter of two eye-like pigment spots being the chief point of difference, and even these often being absent. In *Zygoselmis* they have not been observed at any stage of the infusorian's life-history. The form here referred to as *Z. acus* undoubtedly belongs to the genus in which it is now placed. Its ability to change its shape is not often exercised, but when the need arises, the alteration is rapid and conspicuous. Its favorite haunt seems to be dead and partially empty algal cells, where several of the species can usually be found in the small pool affected by them.

ORDER HETEROMASTIGODA, *Bütschli*.

Family BODONIDÆ, *Bütschli*.

Genus BODO, *Ehr*.

BODO INTESTINALIS, *Ehr*.

Observed by Dr. Joseph Leidy in the rectum of the common toad, *Bufo Americanus*.

BODO HELICIS, (*Leidy*) *Diesing*.

Discovered by Dr. Leidy in the copulatory tubes of various *Helices*.

BODO JULIDIS, *Leidy*.

Discovered by Dr. Leidy in the intestine of *Julus marginatus*.

BODO MELOLONTHÆ, *Leidy*.

Discovered by Dr. Leidy in the intestine of Cockchafers, *Melolontha*.

BODO MUSCORUM, *Leidy*.

Discovered by Dr. Leidy in the intestine of the common house-fly.

Genus HETEROMITA, *Duj*.

HETEROMITA LENS, (*Müll.*) *S. K.*

HETEROMITA MUTABILIS, *Stokes*. Pl. I, fig. 47.

Heteromita mutabilis. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body ovate or subpyriform, about twice as long as broad, very soft, flexible and changeable in shape, the alterations con-

finer chiefly to the posterior extremity, and consisting of varied pseudopodial extensions of this part, which is normally widest and rounded; endoplasm granular; anterior vibratile flagellum thick, slightly exceeding the body in length, the posterior or trailing appendage slender, twice to two and a half times that length; nucleus obscure, apparently subspherical, near the centre of the left-hand border; contractile vesicle near the right-hand margin of the posterior extremity. Length of body $\frac{1}{3000}$ inch. Habitat.—Standing pond-water, with aquatic plants. Movements evenly and steadily forward.

Although this infusorian can assume various shapes apparently at will, it is remarkable for the presence and variety of the posterior protrusions of the body-sarcode. These are usually almost constantly formed during the creature's progression, one scarcely disappearing before its place is taken by another of different shape and length. The tips of these pseudopodial prolongations seem to be adhesive, since they appear to cling to the surface of the glass slide, and to require a slight effort for their release. The production of these characteristic prolongations, which, so far as I am aware, have not hitherto been observed in any other species of the genus except *H. lens* (Müll.), S. K., when in a dying condition, together with the posterior location of the contractile vesicle, which, with this exception, is placed so close to the rear in *H. lens* only, are of diagnostic value, and will readily lead to the recognition of the infusorian. From *H. lens*, for which it is hardly possible to mistake it, *H. mutabilis* can be distinguished by its normally ovate or subpyriform contour, but chiefly, apart from the posterior changes of shape, by the diverse length and thickness of the flagella. In *H. lens* the latter are both equal in size and about equal in length, being twice as long as the body.

HETEROMITA VARIABILIS, Stokes. Pl. I, figs. 42–46.

Heteromita variabilis. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body soft, flexible, and very changeable in shape, subspherical, ovate-elongate, subcylindrical, frequently with both extrem-

ities curved towards the ventral aspect, and often with the anterior border slightly and obliquely emarginate; endoplasm granular; flagella very unequal in length, the trailing appendage twice as long as the contracted body, the vibratile one-third or one-fourth of the length of the body; contractile vesicle single, spherical, located near the centre of the ventral surface; nucleus single, subspherical, near the posterior extremity. Length of body $\frac{1}{2250}$ to $\frac{1}{1125}$ inch. Habitat.—The apparently empty body of a dead *Canthocamptus minutus*, Müller.

The figures show some of the changes in form assumed by this remarkably metabolic creature, of which the posterior extremity is especially soft and changeable in shape. The infusorian differs from all other members of its genus in the proportionate length of the flagella, the vibratile appendage being shorter than that of any previously recorded species. The animalcules were observed crowding the empty body of a dead *Canthocamptus*.

HETEROMITA OVATA, Duj.

HETEROMITA PUTRINA, Stokes. Pl. II, figs. 6 and 7.

Heteromita putrina. Stokes: Am. Nat., Feb., 1884.

Body ovate, rounded anteriorly, tapering posteriorly to a somewhat obtuse point; surface smooth; endoplasm enclosing several dark-bordered refractive particles; nucleus obscure, apparently centrally placed in the median line; contractile vesicle conspicuous, situated near the right lateral margin of the anterior body-half; the vibratile flagellum but slightly exceeding the body in length, the trailing gubernaculum about three times as long as the zoöid, both being of equal size and inserted anteriorly. Length of body $\frac{1}{3000}$ to $\frac{1}{4500}$ inch. Habitat.—The putrid water of animal macerations.

The creature, when in a healthy and comfortable condition, is very slightly if at all changeable in shape. When about to die it takes a subspheroidal form and becomes diffluent, but this stage is at times postponed until the animal has passed a short period as a granular amœba, with a large and conspicuous con-

tractile vesicle, slowly moving by a forward flow of a sarcode wave unaccompanied by the posteriorly located granules. The motion of the *Heteromita* when swimming is rapid and oscillating, being a forward movement by short zig-zags, the animal at the same time rotating on its longitudinal axis.

The anterior vibratile flagellum is ordinarily extremely difficult to detect. The zoöid, when attached, rests at the extremity of its anchoring flagellum, and when viewed dorsally the vibrating lash is visible for only the very short distance between its origin and the point where it curves to pass beneath the lower or ventral surface. Even when in a favorable position for its own demonstration, the rapidly moving filament becomes visible only after careful manipulation of the mirror, or after the infusorian has been killed by iodine or osmic acid. Small particles are not affected by its motion until they have floated past the anterior margin of the body, sometimes almost in contact with the surface, when they fall into the stream and are dashed upward, at times performing a complete circuit around the animal to the starting point. If solid food is taken, it must enter through the ventral surface. No solid particle has been seen to pass into the endoplasm, although I have tried to feed the creatures with indigo, and have had the same individuals in a growing-slide for four full days, surrounded by myriads of bacteria.

Family ANISONEMIDÆ, S. K.

Genus ANISONEMA, Duj.

ANISONEMA GRANDIS, (Ehr.) Stein.

ANISONEMA EMARGINATA, Stokes. Pl. II, fig. 8.

Anisonema emarginatum. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body suborbicular, depressed, the frontal border somewhat narrowed, rounded, and centrally emarginate, the dorsal surface convex, the ventral slightly concave; flagella subequal in size, the anterior or vibratile about twice as long as the body, the trailing appendage slightly longer, both inserted near together somewhat toward the right-hand side of the frontal emargina-

tion; contractile vesicle single, in the anterior body-half near the right-hand margin; nucleus not observed; endoplasm granular, enclosing numerous dark-bordered linear corpuscles. Length of body $\frac{1}{1800}$ inch. Habitat.—Standing water, with *Myriophyllum* and other aquatic plants.

ANISONEMA SOLENOTA, *Stokes*. Pl. I, fig. 48.

Anisonema solenotum. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body subelliptical, depressed, less than twice as long as broad, slightly narrowed at the anterior extremity, the posterior border rounded, the frontal margin slightly and narrowly truncate; ventral surface flat, the dorsal longitudinally traversed by a subcentral depression or groove; oral aperture distinct; flagella diverse in length, the vibrating appendage about as long as the body, the trailing one, or gubernaculum, twice that length; contractile vesicles two, situated opposite each other in the anterior body-half, near the median groove; nucleus single, sub-spherical, subcentrally placed near the left-hand body-margin; endoplasm colorless, transparent. Length $\frac{1}{1000}$ inch. Habitat.—Standing pond-water.

ANISONEMA PUSILLA, *Stokes*. Pl. I, fig. 49.

Anisonema pusilla. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Body subelliptical, less than twice as long as broad, depressed, the two extremities narrowed and obtusely pointed, the ventral surface often slightly concave, the dorsal convex and longitudinally furrowed; anterior flagellum subequal to the body in length, the posterior or trailing appendage about three times as long as the zoïd, both originating near together on the ventral aspect a short distance back of the frontal apex; pharyngeal passage minute, but distinct; contractile vesicle apparently single, subcentrally located; nucleus not observed; endoplasm frequently enclosing small dark particles, probably food fragments. Length of body $\frac{1}{2250}$ inch. Habitat.—Pond-water. Movements oscillating, not rapid.

*Genus ENTOSIPHON, Stein.**ENTOSIPHON OVATUS, Stokes. Pl. II, fig. 9.**Entosiphon ovatus.* Stokes: Ann. Mag. Nat. Hist., June, 1885.

Body ovate, somewhat depressed, a little less than twice as long as wide, rounded posteriorly, narrowed anteriorly, and slightly curved toward the ventral aspect, the frontal border somewhat emarginate on the left-hand side, the cuticular surface traversed by ten or twelve longitudinal sulci; the two flagella inserted near together on the left-hand side of the pharyngeal aperture, the posterior or trailing appendage about twice as long as the body, the anterior or vibratile not exceeding the body in length; pharyngeal tube protrusible, extending backwards for fully four-fifths of the entire length of the body; contractile vesicle single, near the left-hand border of the frontal margin; nucleus spherical, near the centre of the left-hand border. Reproduction by longitudinal fission. Length of body $\frac{1}{900}$ to $\frac{1}{1000}$ inch. Habitat.—An infusion of dead leaves.

Entosiphon sulcatus (Duj.), Stein, has the trailing flagellum from two to three times as long as the body, the cuticular sulci are but four or five, and the animalcule is very much smaller than the form here described. The contractile vesicle has been observed to become rosette-shaped in *E. ovatus*, as it has in the form from European waters. Reproduction by longitudinal fission, beginning at the anterior border, has been noticed in both.

Family NOTOSOLENIDÆ, Stokes.

Animalcules free-swimming, persistent in form, bearing two flagella, the larger and longer extended in advance, the shorter and smaller trailing; oral aperture, obscure, but present; endoplasm colorless.

Genus NOTOSOLENUS, Stokes.

Animalcules free-swimming, depressed, persistent in shape, more or less ovate, the anterior extremity not curved to either

side; ventral surface convex, the dorsal made concave by a sub-central longitudinal groove or broad depression; flagella two, diverse in length and size, the longer held obliquely forward and distally vibratile, the shorter or ventral gubernaculum trailing, both originating near the anterior extremity, the shorter from the convex ventral aspect; anal aperture postero-terminal.

NOTOSOLENIUS APOCAMPTUS, *Stokes*. Pl. II, figs. 10 and 11.

Solenotus apocamptus. Stokes: Am. Jour. Sci., July, 1884.

Notosolenus apocamptus. Stokes: Am. Jour. Sci., Aug., 1884.

Body depressed ovate, the length about one and one-third times the width; the anterior body-half somewhat flattened, the anterior extremity with rounded borders but tapering to a sub-acute, slightly projecting apex; the posterior body-half narrowing, the extremity convex but somewhat truncate; ventral aspect smoothly convex; dorsal concavity narrowest at its anterior origin, widening and continuing evenly to its posterior termination; flagella diverse in length and thickness, the longer and larger once to one-half times as long as the body, inserted at the apex, and commonly held stiffly and obliquely in advance, the distal end alone vibrating; the shorter trailing, about one-third the length of the body, slender, arising from a point at a little distance from the anterior apex of the convex or ventral surface; endoplasm granular, especially posteriorly; contractile vesicle single, small, located anteriorly near the right-hand border; nucleus obscure, apparently placed subcentrally near the left-hand margin. Length of the body $\frac{1}{2500}$ to $\frac{1}{3750}$ inch. Habitat.—Standing water, with *Myriophyllum*.

These minute creatures are deliberate but eccentric in their movements, with the additional eccentricity of appearing to float back downward, having in that position the convex ventral surface, which an observer would at first glance decide to be the dorsal. That it is in reality the ventral aspect is proven by the fact that the short, trailing flagellum not only takes its origin from a point on that surface, but is habitually held beneath the

convexity. It is scarcely possible that a non-vibratile appendage could be of much service as a drag or as a pivot on which to turn, as this infusorian turns, if carried above the dorsum. Yet the animal frequently moves with this convex part directed upward, although this is the less common position. The long flagellum is entirely flexible, but usually only the distal extremity is vibratile. It is commonly held directed stiffly and obliquely toward one side as the animalcule floats with either surface downward, as shown in the figures. In figure 10, is delineated the ventral aspect to exhibit the comparative length, origin, and usual position of the short flagellum; in figure 11, is shown the dorsal surface to exhibit the longitudinal depression or concavity.

When moving through the water, the infusorian advances in a direct course steadily and not rapidly for a few moments, when it quickly and abruptly turns aside at an acute angle, the long flagellum then being thrown into indescribable curves and flexures, but in the general direction of the route to be taken.

No distinct oral aperture is visible. On several occasions numerous minute green particles, presumably of food, have been noticed within the endoplasm.

NOTOSOLENUS SINUATUS, Stokes. Pl. II, figs. 12 and 13.

Notosolenus sinuatus. Stokes: Am. Nat., xix, May, 1885.

Body depressed, broadly and irregularly ovate or subtriangular, somewhat longer than broad, widest posteriorly, gradually tapering through the posterior two-thirds, thence rapidly narrowing to the rounded frontal margin, the lateral borders frequently concave or undulate, the posterior extremity truncate, more or less emarginate; dorsal depression narrow, deep, with an anterior keel-like elevation; ventral surface smoothly convex; long flagellum vibratile at its distal end only, somewhat less than twice as long as the body, held stiffly and obliquely in advance towards the right-hand side; short or trailing flagellum about one-half as long as the body, usually extending obliquely

backward toward the right-hand border; nucleus apparently single, spherical and near the centre of the left-hand side, the contractile vesicle in front, and near the opposite margin; endoplasm colorless, transparent, posteriorly enclosing granules and green particles. Length of body $\frac{1}{1125}$, greatest width $\frac{1}{1500}$ inch. Habitat.—Standing water, with dead leaves.

The appearance of a short pharynx is constantly present, the tract being more clearly defined than in any other species of the genus.

NOTOSOLENUS ORBICULARIS, *Stokes*. Pl. II, fig. 14.

Solenotus orbicularis. Stokes: Am. Jour. Sci., July, 1884.

Notosolenus orbicularis. Stokes: Am. Jour. Sci., Aug., 1884.

Body suborbicular, the anterior apex obtuse, the posterior extremity rounded, not truncate, the posterior one-half of the left-hand border usually angular; dorsal concavity broad and shallow; ventral surface evenly convex; flagella, nucleus and contractile vesicle similar to those of the preceding species. Length of the body $\frac{1}{2200}$ to $\frac{1}{2500}$ inch. Habitat.—Near the bottom of the shallow water of small pools.

This infusorian differs from that described as *Solenotus apocamptus*, chiefly in its contour, its shorter dorso-ventral or vertical diameter, and in the shallowness and greater comparative width of the dorsal depression. Its movements are similar to those of *S. apocamptus*, the long flagellum being held somewhat more obliquely than with that species. The body is frequently elevated during its progression, so that the apex seems to be held in contact with the slide. The anterior body-half is transparent; colorless corpuscles and green food-particles collected posteriorly often render that part semi-opaque.

Genus CLOSTENEMA, *Stokes*.

Animalcules naked, free-swimming, fusiform or elongate, persistent in shape; flagella two, diverse in length, originating near together at the anterior border, the longer extended in advance,

the shorter usually held beneath the lower surface, both vibratile; pharyngeal passage present, and apparently communicating with the contractile vesicle.

CLOSTENEMA SOCIALIS, Stokes. Pl. II, fig. 15.

Clostenema socialis. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body fusiform, three times as long as broad, the frontal border obliquely emarginate, the posterior extended in a short rounded prolongation; long flagellum equalling or exceeding the body in length, the short appendage about one-fourth or one-fifth the length of the infusorian; pharyngeal passage extremely narrow; contractile vesicle double, in the anterior body-half, near one lateral border; nucleus apparently subcentral; endoplasm colorless, slightly granular. Length of body $\frac{1}{1500}$ inch. Anal aperture not observed. Habitat.—Standing water, with *Lemna*. Gregarious.

Reproduction takes place by longitudinal fission, presumably after conjugation, which has been observed. While swimming the animalcules advance evenly and rather slowly without revolution on their axis, the long flagellum being held in advance, the distal extremity most actively vibrating. The favorite position seems to be a quiescent one in companies, with the frontal border in contact with a mass of debris, or an algal filament, the flagella vibrating and extending quickly in various directions. No oral aperture could be positively discerned, although what I have interpreted as a very narrow pharyngeal passage was apparent. The granules within the endoplasm have a tendency to collect in the posterior prolongation, as if an anal aperture might be present there, but none has yet been noticed. The entrance of solid food-particles through the pharynx also escaped prolonged observation.

The short flagellum, which, although vibratile, is more or less trailing, and is habitually held beneath the body. Several individual animalcules have been observed with a bulbous enlargement to the distal extremity of the long flagellum.

ORDER ISOMASTIGODA, *Bütschli*.Family SPONGOMONADIDÆ, *Stein*.Genus SPONGOMONAS, *Stein*.SPONGOMONAS INTESTINALIS, (*Cienk.*) *Stein*.

Spongomonas intestinalis. Stokes: Am. Jour. Micros. and Popular Science, Oct., 1881.

SPONGOMONAS DISCUS, *Stein*.SPONGOMONAS SACCULUS, *S. K.*Genus RHIPIDODENDRON, *Stein*.RHIPIDODENDRON SPLENDIDUM, *Stein*.

Rhipidodendron splendidum. Ryder: Am. Nat., Nov., 1880; Stokes: Am. Jour. Micros., Oct., 1881.

RHIPIDODENDRON HUXLEYI, *S. K.*FAMILY CHRYSOMONADIDÆ, *Bütschli*.Genus CHRYSOPYXIS, *Stein*.CHRYSOPYXIS URCEOLATA, *Stokes*. Pl. II, fig. 16.

Chrysopyxis urceolata. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Lorica urceolate, less than twice as long as broad, widest anteriorly, tapering posteriorly to an obtusely rounded point of attachment, the margins then convex, or with nearly straight lateral borders and an acute point of attachment; narrowed anteriorly and prolonged as a short, truncate, neck-like portion with slightly converging margins; animalcule subspheroidal, occupying the centre of the lorica, to which it is in no way attached; flagella projecting considerably beyond the lorica mouth, widely diverging; color-bands yellow, laterally placed; contractile vesicle single or double, minute, posteriorly located. Length of lorica $\frac{1}{2250}$ inch. Habitat.—Fresh water; attached to filamentous Algæ. Gregarious.

CHRYSOPLYXIS TRIANGULARIS, *Stokes*. Pl. II, fig. 17.

Chrysopyxis triangularis. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Lorica triangular, sessile, compressed, the height slightly exceeding the breadth, the posterior extremity truncate, the basal angles rounded; lateral margins converging, with a more or less conspicuous subcentral rounded projection; aperture apical, the border produced as a short, subcylindrical neck, the anterior margin truncate, not everted; enclosed animalcule subspherical, yellowish. Height of lorica $\frac{1}{1800}$, width at base $\frac{1}{1500}$ inch; diameter of enclosed zoöid $\frac{1}{6000}$ to $\frac{1}{4500}$ inch. Habitat.—The cypress swamps of South Florida; abundant on various confervoid Algæ.

CHRYSOPLYXIS MACROTRACHELA, *Stokes*. Pl. II, fig. 18.

Chrysopyxis macrotrachela. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Lorica somewhat bottle-shaped, the body triangular, about twice as high as wide, the posterior border truncate, the basal angles rounded, the lateral margins converging, slightly convex; aperture apical, the border produced as a long, narrow, subcylindrical neck-like prolongation, in length equalling or slightly exceeding the height of the lorica body, the anterior margin truncate, conspicuously everted. Height of lorica without the neck $\frac{1}{3000}$, width at base $\frac{1}{1800}$ to $\frac{1}{1500}$; length of neck $\frac{1}{3000}$ to $\frac{1}{2250}$ inch. Habitat.—In company with *Ch. triangularis*, but less abundant.

CHRYSOPLYXIS AMPULLACEA, *Stokes*. Pl. II, fig. 19.

Chrysopyxis ampullacea. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Body of the lorica subhemispherical, the posterior border truncate, the lateral margins rounded; aperture produced as a neck-like prolongation in length equalling the diameter of the lorica, narrowest at its origin, the lateral borders gradually

diverging to the truncate frontal margin. Height and diameter of the lorica body and length of neck $\frac{1}{2250}$ inch; diameter of the enclosed animalcule $\frac{1}{6000}$ inch. Habitat.—The cypress swamps of South Florida.

CHRYSOPYXIS DISPAR, *Stokes*. Pl. II, figs. 20 and 21.

Chrysopyxis dispar. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Lorica urceolate, once and a half to twice as long as broad, widest anteriorly, tapering posteriorly to a subacute point of attachment, the lateral borders then nearly straight, or the body of the lorica subspherical, tapering, and constricted posteriorly; both forms narrowed anteriorly to produce a straight, more or less conspicuous neck-like prolongation, a curved partition extending transversely across the lorica near the centre, and dividing its cavity into two unequal parts; animalcule subspheroidal, not attached to the lorica, but supported by the transverse partition; color-bands yellow, lateral. Length of lorica $\frac{1}{1800}$ to $\frac{1}{1500}$ inch. Habitat.—Fresh water; on confervoid Algæ, in company with *Chrysopyxis urceolata*.

Genus DEREPYXIS, *Stokes*.

Animalcule single, inhabiting a pedicellate, flask-shaped lorica, to which it is in no way attached; zoöid subspherical, enclosing two laterally disposed color-bands; flagella two, subequal, rising from the centre of the frontal margin; contractile vesicles two; pharynx presumably represented by a small, colorless space at the base of the flagella.

This is near the *Chrysopyxis* of Stein, resembling it in the form of the enclosed zoöid, its biflagellate condition and its entire freedom within the protecting sheath, but differing in the constantly pedicellate character of the lorica, the latter, with *Chrysopyxis*, being sessilely attached to its support.

DEREPYXIS AMPHORA, *Stokes*. Pl. II, fig. 22.*Derepyxis amphora*. Stokes: Am. Jour. Sci., April, 1885.

Lorica flask-shaped, transparent, two and one-half to three times as long as broad, narrowed posteriorly and produced anteriorly in a cylindrical neck-like portion of one-fifth the entire lorica in length, its circular border truncate, not everted; pedicle short, stout, about one-tenth as long as the lorica; enclosed animalcule occupying the centre of the sheath, subspherical, somewhat compressed; the frontal border slightly pointed, this part usually colorless; endoplasm with two, lateral, broad, greenish-yellow color-bands; flagella even, diverging, and projecting for a considerable distance beyond the lorica aperture; nucleus not observed; contractile vesicles two, postero-terminal, pulsating alternately. Reproduction by longitudinal fission. Height of lorica $\frac{1}{900}$ inch; length of enclosed zoöid $\frac{1}{1500}$ to $\frac{1}{2000}$ inch. Habitat.—Pond-water; attached to algal filaments.

The lateral color-bands are often so broad that they appear to surround the entire body, a high amplification then being needed to demonstrate the narrow line of colorless protoplasm separating them longitudinally. The infusorian is gregarious in habit.

DEREPYXIS OLLULA, *Stokes*. Pl. II, fig. 23.*Derepyxis ollula*. Stokes: Am. Jour. Sci., Apr., 1885.

Lorica broadly flask-shaped, one and one-half times as long as broad, centrally subspherical, slightly narrowed at the posterior extremity, the neck-like portion subcylindrical, one-fourth as long as the entire lorica, the circular border not everted; pedicle short, stout, in length about one-eighth of the entire height of the lorica; enclosed zoöid spherical, the anterior border rounded; lateral color-bands as in *Derepyxis amphora*; flagella of equal length; contractile vesicles posteriorly located, but not terminal. Height of lorica $\frac{1}{1125}$ inch; diameter of enclosed animalcule $\frac{1}{2250}$. Reproduction by longitudinal fission. Hab-

itat.—Pond-water; attached to confervoid filaments. Solitary or few together.

Genus SYNURA, Ehr.

SYNURA UVELLA, Ehr.

Genus UVELLA, Ehr.

UVELLA VIRESCENS, Ehr.

Genus CYCLONEXIS, Stokes.

Animalcules laterally joined to form free-swimming annular colonies, the zooids illoricate; flagella two, one long, the other short, both vibratile; endoplasm enclosing two laterally disposed color-bands; eye-like pigment specks absent. Habitat.—Fresh water.

This differs from *Uvella*, which it most closely resembles, in the lateral instead of a posterior union of the constituent animalcules, in the annular rather than a spheroidal form of the colony, and in the very diverse length of the two flagella.

CYCLONEXIS ANNULARIS, Stokes. Pl. II, figs. 30 and 31.

Cyclonexis annularis. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Colony composed of from ten to twenty zooids, the posterior extremities of the constituent animalcules in young and small clusters occasionally in contact, in older and larger colonies remote, leaving a central more or less circular space; bodies obovate, compressed, about twice as long as broad, obtusely pointed anteriorly, rounded and narrowed posteriorly; long flagellum equalling or exceeding the body in length, the short appendage about one-half as long, usually convoluted spirally; contractile vesicle double, small, spherical, located in the anterior body-half, near one lateral border; color-bands yellowish. Length of body $\frac{1}{1800}$ to $\frac{1}{2250}$ inch; diameter of the annular colony $\frac{1}{900}$ inch or less. Movements rotatory. Habitat.—Marsh-water, with *Sphagnum*.

*Family TETRAMITIDÆ, Bütschli.**Genus TETRAMITUS, Perty.***TETRAMITUS VARIABILIS, Stokes.** Pl. II, figs. 24-26.*Tetramitus variabilis.* Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Body soft, changeable in shape, obovate, with the anterior border obliquely excavate, a short lip-like prominence at its upper angle, or subpyriform or subspherical, the frontal border rounded, the posterior extremity obtusely pointed or evenly convex; flagella four, subequal, exceeding or equalling the body in length, inserted near the centre of the anterior extremity; contractile vesicles two, situated near the frontal border, not close together; nucleus obscured by the granular endoplasm; food engulfed at any portion of the surface; body without grooves. Length, $\frac{1}{1125}$ to $\frac{1}{1500}$ inch. Habitat.—Standing water with decaying vegetation, from South Florida.

This form markedly differs from the three previously described species in the entire absence of the longitudinal grooves and flattened cuticular surfaces characteristic of those animalcules. The species here described was observed among decaying vegetation with water from the cypress swamps of South Florida. It was accompanied by very many forms familiar in our more northern waters, and is itself probably not restricted to Florida.

TETRASELMIS LIMNETIS, Stokes. Pl. III, fig. 4.*Tetraselmis limnetis.* Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Lorica broadly oval, the length but slightly exceeding the width, both extremities evenly rounded; body of the enclosed zoöid almost entirely filling the cavity of the lorica, the endoplasm green, granular, with a small, colorless, transparent spot at the anterior border; flagella four, each exceeding the lorica in length; contractile vesicles two, small, situated one on each side of the frontal clear space; nucleus not observed; a large,

subspherical amylaceous corpuscle posteriorly located. Length of lorica $\frac{1}{1800}$ inch. Habitat.—Pond-water.

This is only the second known species of the genus.

Genus EXECHLYGA, Stokes.

Animalcules free-swimming, soft and flexible, ovate; three long, subequal, vibratile flagella produced from the anterior extremity; an undulating membrane developed along one lateral border, and terminating posteriorly in a long flagellum; a motionless rod-like body traversing the zoöid longitudinally and projecting beyond the posterior extremity; oral aperture none; contractile vesicle absent. Habitat.—Endoparasitic.

EXECHLYGA ACUMINATA, Stokes. Pl. II, fig. 32.

Exechlyga acuminata. Stokes: Am. Nat., Nov., 1884.

Body ovate, widest and rounded posteriorly, tapering to the somewhat pointed anterior apex, length two and one-half to three times the width; parenchyma colorless, often vacuolar; anterior flagella three, as long as the body, subequal and fine; undulating membrane narrow, its margin apparently thickened, the line of insertion usually conspicuous, and its posterior border terminating in a fine filament subequal to the zoöid in length; internal rod-like body curved, anteriorly enlarged, the distal extremity of the posteriorly projecting portion suddenly acuminate; nucleus not observed. Length of body $\frac{1}{1000}$ inch. Habitat.—The rectum of the spade-foot hermit toad, *Scaphiopus Holbrookii*.

The body is here extremely soft, its consistency seeming scarcely more than that of the white of an egg. The endoplasm is also usually more or less vacuolar, becoming conspicuously so when the animalcules are surrounded by water on the microscope slide, the vesicles varying in size, and often changing their position rapidly. A true contractile vesicle is absent. The nucleus also is obscure. Occasionally a small refringent disc, usually

structureless, rarely granular, is noticeable near the centre of one lateral border, and may be the nucleus.

The point at which the pliant rod-like body leaves the posterior extremity of the infusorian is well marked, the cuticular surface occasionally appearing to surround it for a short distance like a sheath. When the animalcule is immersed in pure water it becomes shortened and permanently fusiform, and this rod then protrudes an increased length which small protoplasmic drops often cover. What the function and constitution of this motionless and refringent structure may be, it is difficult to conjecture.

No oral aperture is visible. Very rarely a few small dark-bordered granules are noticeable within the body, but if they are of external origin their mode of entrance is unknown.

Although existing in great profusion, I have observed their reproduction in but a single instance. The cause is probably the case with which they lose their health in water. They are tenacious of life, however, individuals living for twenty-four hours within a rectum in a life-slide, but water does not agree with them. In this single instance multiplication took place with amazing rapidity. A drop of sarcode separated from the posterior extremity of the body quickly followed by another, both immediately assuming a spherical form and both almost immediately rupturing and with some force shooting out a zoöid less than one-fourth the parent's size and with the undulating membrane less developed, but otherwise resembling it. Fission, encystment, rupture and escape were all accomplished in less than two seconds. I have witnessed this but once, as stated, yet before seeing it I had repeatedly observed an act whose significance I failed to appreciate until it had been examined in the reflected light of the completed process. It is, that a portion of the posterior extremity of the animalcule frequently becomes separated, but immediately undergoes disintegration or diffuence, and probably represents an attempt at reproduction made incomplete by unpropitious surroundings. The multitudinous young are much smaller than the adults, more spindle-shaped and more active.

*Family POLYMASTIGIDÆ, Bütschli.**Genus HEXAMITA, Duj.**HEXAMITA GYRANS, Stokes. Pl. III, fig. 1.*

Hexamita gyrans. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body ovate or subspherical, somewhat depressed, less than twice as long as broad, soft and changeable in shape; flagella exceeding the body in length, the two trailing appendages originating from the posterior extremity at some distance apart, the four anterior vibratile, arising at some distance from the frontal border, and arranged in two groups of two flagella each, the two forming each group arising opposite one another with the thickness of the body between them, the free ends often curved; contractile vesicle small, anteriorly situated. Length of body $\frac{1}{3000}$ inch. Habitat.—Standing pond-water. Movements extremely rapid and rotatory on the longitudinal axis, the anterior flagella then rigidly extended at right angles to the body, their distal extremities alone vibrating.

The endoplasm seems to be semi-fluid; it is, at least, remarkably soft, rapidly circulating within the flexible but firmer ectoplasm, carrying in its course the enclosed granules, and also apparently the contractile vesicle. In reference to the latter it is difficult to determine, as the infusorian's quiescent periods are neither long nor frequent, but the contractile vesicle certainly seems to expand when near the posterior extremity, pass with the endoplasmic current to a certain point on the antero-lateral border, and there to contract and disappear.

HEXAMITA SPIRALIS, Stokes. Pl. II, fig. 33.

Hexamita spiralis. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body elongate-obovate, about four times as long as broad, the anterior extremity rounded, the posterior obtusely pointed; anterior flagella four in number, vibratile, arising close together, their length diverse but exceeding that of the body, the two

shortest extended opposite each other at right angles to the body, their distal extremities curved forward; the remaining two extending backward, each forming a long, loose spiral; trailing flagella two, arising from the tip of the posterior extremity, and exceeding the body in length; contractile vesicles two, situated opposite each other in the anterior body-half; nucleus obscure. Length of body $\frac{1}{2250}$ inch. Habitat.—The intestinal canal of the tadpole of the common toad. Movements by rapid rotation on the longitudinal axis.

This differs from previously observed species in the presence of two contractile vesicles, and in the spiral disposition of two of the anterior flagella.

Family CRYPTOMONADIDÆ, Bütschli.

Genus CHILOMONAS, Stein.

CHILOMONAS PARAMÆCIUM, Ehr.

Chilomonas paramæcium. Foulke: Jour. New York Micros. Soc., 1885.

Reproduction takes place frequently and rapidly by longitudinal fission, and by a method first observed by Miss S. G. Foulke, of Philadelphia, from whose account the following is quoted:

“While I was investigating a drop of water teeming with *Chilomonas*, a minute flagellate amœboid form entered the field, and after swimming uncertainly about for some moments, settled to the bottom of the live-box, where it moved in amœboid fashion, the two flagella becoming merged in the pseudopodia-like processes. The presence of about twenty small highly refractive bodies, suspected to be germs, was noticed. Soon the mass became so diffused as to form a mere film, and presently disintegrated, setting free these bodies, which swam away. Several similar individuals were found, some of which, on becoming quiescent, took a globular shape, retaining both flagella to the last. This sphere then grew larger and its wall thinner until, like a bubble, it burst, liberating the germs,

which were always present, and very active. So many of these forms were now found, while the number of the adult forms of *Chilomonas* at the same time diminished, that the identity of the two was suspected; and the suspicion was verified almost immediately by my witnessing the transformation throughout.

"An individual would begin to spin round, gradually losing contour, while the refractive corpuscles ranged near the cell wall left their places and moved actively about, showing, as did also the increased transparency of the cell, incipient liquefaction of the endoplasm. An amœboid character was now assumed until, finally, one or the other of the two phases above noted was entered upon. When the final shape was that of an amœboid film the freeing of the germs was effected in various ways. Sometimes, as stated, the film became disintegrated. In other cases, one large external vesicle was formed, leaving only a very small portion of protoplasm enclosing the germs, and from this the germs energetically freed themselves after the bursting of the vesicle. In still others, a small vesicle formed about the germs and, moving to the cell wall, extended itself, and burst, liberating the germs directly into the water, after which, the remainder of the animalcule disintegrated.

"In from four to five days each of these germs developed into an adult *Chilomonas*, having the characteristic form at an early stage of growth."

CHILOMONAS OVATA, Stokes. Pl. II, figs. 27-29.

Chilomonas ovata. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body evenly ovate, persistent in shape, once and one-half to twice as long as broad, rounded posteriorly, somewhat narrowed anteriorly, the frontal border obscurely bilabiate; flagella subequal, exceeding the body in length, inserted close together at the anterior apex; contractile vesicles two, pulsating alternately, situated near the frontal margin; nucleus posteriorly placed; endoplasm enclosing numerous, dark-bordered corpuscles.

Length of body $\frac{1}{2250}$ to $\frac{1}{1800}$ inch. Habitat.—The bacterial pellicle on the surface of vegetable infusions.

This form is readily distinguishable from *Chilomonas paramacium* by its much smaller size, by its long flagella, and particularly by the presence of two contractile vesicles, with the indistinct bilabiation of the frontal apex.

The dark-bordered corpuscles so numerous within this and *Chilomonas paramacium* are of an amylaceous nature, as is proved by their change to an intensely blue color when the animalcule is killed with iodine. The nucleus is usually so completely hidden by these superposed starchy corpuscles that it is positively located with difficulty. In several individuals, however, these bodies have chiefly collected in the anterior portion of the zoöid, in which cases what I have taken to be the nucleus has been left in an almost subterminal position.

Reproduction is accomplished by conjugation followed by encystment and quadruple subdivision. Union takes place by the adhesion of the two frontal borders, the body contents of one animalcule slowly passing into and mingling with those of the other, the latter gradually assuming a spherical form and exhibiting four actively-moving flagella, as in figure 28. That the zoöids possess a distinct cuticular investment is proved during this process of protoplasmic transfer, for at that time, as shown in figure 29, the posterior portion of the cuticular coat is left empty, the space slowly increasing in size until after the conjugation has been consummated; the completely vacated cuticular sac adheres to the quadriflagellate spherical result of the genetic union, as shown in figure 28, whence it gradually melts away. The ultimate fate of the flagella I could not positively determine; my impression is, however, that they are absorbed. They remain visible and active for a considerable time after conjugation; in one instance a single flagellum did not entirely disappear until fission in one plane had been almost completed. The cuticular surface of one of the united animalcules, swollen into a sphere, becomes the cyst wall within which quadruple division

takes place, the four young zooids thus formed differing from the mature infusorian apparently in size only.

Genus CRYPTOMONAS, Ehr.
CRYPTOMONAS OVATA, Ehr.

Genus TRENTONIA, Stokes.

Animalcules free-swimming, soft and somewhat changeable in shape, biflagellate, one flagellum trailing, one vibratile; frontal border slightly bilabiate; trichocysts not observed; otherwise as in *Raphidomonas*, Stein.

TRENTONIA FLAGELLATA, Stokes. Pl. III, fig. 3.

Trentonia flagellata. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Body obovate, less than three times as long as broad, the anterior border oblique and somewhat bilabiate, the posterior extremity obtusely pointed; flagella subequal to each other and to the body in length, one extending arcuately forward, often rapidly and spirally vibrating, apparently originating in the oral fossa; the other taking its origin on the ventral or lower surface a short distance behind the anterior extremity, and usually trailing; oral aperture conspicuous, communicating with a capacious subtriangular pharyngeal cavity; contractile vesicle single, spherical, near the anterior extremity; nucleus subspherical, situated near the body-centre; endoplasm enclosing numerous small ovate chlorophyl corpuscles forming a bright-green layer near the cuticular surface. Length of body $\frac{1}{430}$ inch. Movements rotary on the longitudinal axis, not rapid. Reproduction by encystment and subsequent binary fission. Habitat.—Pond-water.

This is very similar to *Raphidomonas semen* (Ehr.) Stein, with two flagella and no apparent trichocysts. When first observed it was without hesitation identified with the above-mentioned European form; but later, while again examining the infuso-

rians, it became evident that the specimens possessed two flagella, while *Raphidomonas* has but one; otherwise they were identical with the form just named, with the exception of the trichocysts. Recently the same infusoria have been collected in a locality remote from the first, and the previous observations confirmed.

The trailing flagellum is ordinarily extremely difficult to see. When the infusorian is rendered uncomfortable and sluggish by prolonged confinement beneath the cover-glass, or partially poisoned by iodine, then the vibratile flagellum, which is usually held stiffly in advance, the tip alone trembling, is flashed into sight as a rapidly undulating spiral, and the trailing appendage is also momentarily directed forward. At other times it also becomes visible when the infusorian is in certain positions or has assumed certain changes of form. How the careful European investigators could have overlooked this trailing appendage is inexplicable, providing, of course, that the present form is *Raphidomonas semen*, with which two flagella are now for the first time observed. It is scarcely possible to believe that Stein would have failed to notice so important an appendage. Yet these two forms are so nearly identical, with the exception of the biflagellate character of the present infusorian, that I confer the generic title *Trentonia* provisionally only.

ORDER CHOANO-FLAGELLATA, *S. K.*

FAMILY CODONOSIGIDÆ, *S. K.*

Genus MONOSIGA, *S. K.*

MONOSIGA CONSOCIATA, *S. K.*

MONOSIGA ROBUSTA, *Stokes*. Pl. III, fig. 6.

Monosiga robusta. *Stokes*: Am. Monthly Micros. Jour., iv, Nov., 1883.

Body ovoid or subspheroidal; collar equalling about one-half the body in height, the flagellum occasionally distally terminating in a bulbous enlargement; pedicle stout, rigid, four to five times as long as the body; contractile vesicles two, posteriorly placed. Length of body $\frac{1}{2000}$ inch. Habitat.—Fresh water;

attached to the rootlets of aquatic plants floating in a tank where water-lilies (*Nymphaea*) were cultivated. Solitary.

MONOSIGA GLOBOSA, S. K.

MONOSIGA WOODIÆ, Stokes. Pl. III, fig. 7.

Monosiga Woodiæ. Stokes: Am. Monthly Micros. Jour., iv, Nov., 1883.

Body ovate, one and one-half times as long as broad, widest centrally, tapering and subacute posteriorly, somewhat constricted immediately beneath the insertion of the collar; pedicle three or four times as long as the body; contractile vesicles two, posteriorly located. Length of body $\frac{1}{2250}$ inch. Habitat.—Fresh water; occasionally in vegetable infusions. Solitary.

MONOSIGA OBOVATA, Stokes. Pl. III, fig. 8.

Monosiga obovata. Stokes: Am. Monthly Micros. Jour., vi, Jan., 1885.

Body smooth, transparent, clavate or obovate, three and one-half to four times as long as broad, widest anteriorly, constricted at the line of insertion of the collar, and attached by the attenuate posterior extremity to the summit of a rigid, comparatively thick foot-stalk about three times the zoöid in length; collar narrow; nucleus and contractile vesicle conspicuous. Length of body $\frac{1}{1000}$ inch. Habitat.—Attached to the rootlets of *Lemna*, in shallow ponds in Western New York.

The body bears a remote resemblance to that of *Monosiga augustata*, S. K. The creature conspicuously differs, however, in being elevated on the long pedicle, in being broader anteriorly, and in possessing a less attenuate posterior extremity. Its size is also very much greater.

MONOSIGA LONGIPES, Stokes. Pl. III, fig. 9.

Monosiga longipes. Stokes: Am. Monthly Micros. Jour., iv, Nov., 1883.

Body gibbously ovate, once and one-half to twice as long as broad; collar exceeding the body in height; pedicle slender, six or seven times as long as the body. Length of the zoöid $\frac{1}{2000}$

inch. Habitat.—Fresh water; attached to Algae growing in the Delaware and Raritan canal.

This form is remarkable for the height of the collar, and the great length of the pedicle.

MONOSIGA LIMNOBIA, *Stokes*. Pl. III, fig. 10.

Monosiga limnobia. Stokes: Am. Monthly Micros. Jour., vii, Dec., 1886.

Body broadly obovate or top-shaped, somewhat changeable in form, longer than wide, tapering posteriorly to the pedicle; flagellum long; pedicle three to four times the length of the body; contractile vesicles two, oppositely situated near the centre of the lateral borders. Length of body $\frac{1}{2\frac{1}{2}50}$ inch. Habitat.—Pond-water. Solitary. This form, aside from its distinctive shape, may be readily recognized by the unusual equatorial position of the contractile vesicles, these being commonly located near to the posterior extremity.

In respect to its habitat it seems somewhat careless. It was first obtained from pond-water that, with *Proserpinaca* and other aquatic plants, had been standing for several months in an aquarium; it was again taken from the fresh waters of a deep pond in early spring, and again on *Utricularia* from the cedar swamps of the New Jersey pine barrens. In all these localities it retained its characteristic form, its solitary life, and the distinctive position of the contractile vesicles. The rich color of the cedar-swamp water had not altered the peculiar pale-green tint so noticeable in the endoplasm of *Monosiga* as well as in the members of the allied genera.

MONOSIGA BREVIPES, *S. K.*

Genus CODOSIGA. *S. K.*

CODOSIGA BOTRYTIS, (*Ehr.*) *S. K.*

CODOSIGA UTRICULUS, *Stokes*. Pl. III, fig. 13.

Codosiga utriculus. Stokes: Am. Monthly Micros. Jour., vi, Jan., 1885.

Bodies elongate-obovate, widest anteriorly, slightly constricted at the point of insertion of the collar, three and one-half to four

times as long as wide; attached by attenuate posterior extremities, in clusters of four, to the summit of a straight, rigid foot-stalk four to five times as long as the zooids, the pedicle occasionally becoming colored chestnut-brown after maturity. Length of body $\frac{1}{2250}$ inch. Habitat.—Fresh water; attached to *Lemna* rootlets.

Several colonies of this species have been met with, among them a single one whose pedicle had assumed, presumably with age, a chestnut-brown color. So far as I am aware there is no record of such color change in connection with the pedicle of any member of the order, and when first observed with this species of *Codosiga* I thought it might possibly be restricted to it, but one of the most beautiful and attractive species, *Codosiga umbellata* (Tatem) S. K., with a compound pedicle resembling, as the specific name indicates, the clustered flower-stalks of the Umbelliferae, at times presents the same peculiarity. Several colonies have been observed in this condition. Indeed, the alteration is not confined to the foot-stalks of these two species, but occasionally even manifests itself in the pedicle of the very common and abundant *Codosiga botrytis* (Ehr.) S. K. It therefore seems probable that the change is not an abnormal one in any of the Order. This alteration from a hyaline, slightly greenish tint to the translucent, chestnut-brown hue calls to mind a similar change of coloration, after maturity, in the loricae of *Cothurnia*, *Pyxicola*, and other members of the Vagicolina, and suggests the probability of a similar chemical composition.

CODOSIGA LONGIPES, Stokes. Pl. III, fig. 5.

Codosiga longipes. Stokes: Am. Monthly Micros. Jour., iv, Nov., 1883.

Bodies gibbously and shortly ovate, once and one-half to twice as long as broad, stationed singly on the extremity of a short, independent, secondary pedicle terminating a slender and extremely long primary foot-stalk, eighteen or twenty times the length of the body of a single zooid. Habitat.—Fresh water; attached to *Myriophyllum*.

CODOSIGA FLOREA, *Stokes*. Pl. III, fig. 16.

Codosiga florea. Stokes: Am. Monthly Micros. Jour., v, March, 1884.

Body shortly campanulate, the length but slightly exceeding the width, the change in shape consisting chiefly of an anterior marginal dilatation, usually rounded posteriorly, and bearing on the anterior body-half a permanent equatorially disposed groove; pedicle slender, eight to ten times the body in height, the secondary pedicles short; contractile vesicles several. Length of body $\frac{1}{4500}$ to $\frac{1}{5000}$ inch. Habitat.—Fresh water. Solitary.

Aside from the distinctive shape, this species has the marked peculiarity of frequently assuming the form of a species of another genus.

When a colony, which I have never seen composed of more than four individuals, has been under observation for a short time, one of the zooids suddenly, and for no discoverable reason, often droops and hangs against the foot-stalk like a flower withering on its stem. A moment later it begins a rapid rotation on its longitudinal axis, and, having twisted itself free, darts in an uncertain, zig-zag course backward through the water. I have seen this occur only when the colony is formed of two members. Occasionally another method of parting company is adopted. The discontented one visibly lengthens its special foot-stalk until it is two or three times the height of the body, and then twists free. The part of this freshly-formed pedicle left on the primary foot-stalk, as well as that carried off by the migrating animal, does not harden in the water, but speedily becomes invisible, in the former instance seeming to melt away, in the latter to be absorbed.

After a longer or shorter voyage, the traveler settles down somewhere and proceeds to erect a pedicle of its own, so that the preparation on the stage soon shows many collar-bearing monads suspended from the cover-glass, lifting themselves from the slide, or resting on the water-weed, each new foot-stalk varying in length with age, and bearing but one terminal zooid. It

is now a *Monosiga*, only needing to assume a method of reproduction by transverse fission to remain a *Monosiga*; and the observer, unless he has first become acquainted with a normal colony, and has witnessed the results of these curious antics, would be more than excusable for a wrong classification of the little creatures. Reproductive division is, however, longitudinal, as with all species of the genus.

The shape of the body during the *Monosiga*-phase does not conspicuously vary from that of the mature animals composing a colony. It is shortly campanulate, the height but little exceeding the width, the posterior part usually evenly rounded, very seldom tapering to the pedicle, and bearing on the anterior body-half the characteristic equatorial groove or depression. In form it is somewhat changeable. As a *Monosiga*, the part immediately beneath the insertion of the collar expands, the opposite extremity contracts, and the creature then presents an appearance much like the corolla of a monopetalous flower. As a *Codosiga*, the bodies at the insertion of the foot-stalk at times somewhat taper, and the internal or opposing surfaces become flattened, thus giving the exterior lateral outline a somewhat gibbous contour.

The depression surrounding the body is permanent. When the animal is killed with picro-carminé it sometimes expands greatly in front and to the rear of this groove, so that the dead body becomes fiddle-shaped. This change I have not observed to take place after using other chemicals, and not always with picro-carminé. The slender pedicle varies in length with the maturity of the creature it supports. When of age, or often when the zoöids part company, each to assume the *Monosiga*-phase, the pedicle is usually from six to eight times the height of the body. Instances rarely occur when the body of a single animal is only one-fourteenth the height of the foot-stalk, the little zoöid having apparently spent its substance in the formation of a stem that shall overtop all its competitors.

CODOSIGA CANDELABRUM, S. K.

CODOSIGA DICHOTOMA, Stokes. Pl. III, fig. 20.

Codosiga dichotoma. Stokes: Am. Monthly Micros. Jour., iv, Nov., 1883.

Bodies subspheroidal or shortly ovate, stationed sessilely on the extremities of a stout, rigid, dichotomously branching foot-stalk composed of a main rachis two or three times the length of the body of a single zoöid, attached to the basis of support and furcately dividing to form two pedicles, each five to six times as long as a single zoöid; both these secondary pedicles also forking together produce four foot-stalks, each supporting, as a rule, a single body, and from four to five times the length of one of the latter. Height of a zoöid $\frac{1}{2400}$ to $\frac{1}{2000}$ inch. Total length of the branching pedicle from twelve to fourteen times that of a single body. Habitat.—Fresh water; on *Myriophyllum*.

CODOSIGA UMBELLATA, (Tatem) S. K. Pl. III, figs. 21 and 22.

CODOSIGA KENTII, (Stokes) S. K. Pl. III, fig. 19; pedicle.

Codosiga umbellata. Kent: Manual of the Infusoria, 1882.

Codosiga Kentii. Stokes: Am. Monthly Micros. Jour., vi, Jan., 1885.

Kent describes a variety of *Codosiga umbellata* differing from his type only in the method of division of the foot-stalk, one having three branches to the main rachis and to each of the secondary divisions, the other with four to each of these parts. The English scientist states that the former is the more prevalent (indeed he has never met with the latter), and seems surprised that such should be the case, since it would appear so much easier and natural for a single collared zoöid to undergo longitudinal fission four times and thus build up a colony whose primary foot-stalk should bear four branches, each of the latter also subdividing into the same number of branchlets. He furthermore questions, but finally accepts, the specific identity of the two forms, concluding that the colony supported by the bitripartite pedicle is the type, the quadripartite being a variety

only, apparently basing his opinion upon the relative abundance of the former. That these two methods of pedicle subdivision indicate two distinct species seems to me correct, but having recently obtained both forms of these elegant creatures in some profusion, I am inclined to the converse of the English scientist's opinion and to accept the quadripartite pedicle as that of the type, and the other, not as a variety, but as a distinct species. Tatem discovered and described the quadripartite colony as a new species of *Epistylis* under the name *E. umbellata*, failing to recognize the delicate, collar-like extension of sarcode surrounding the body and enclosing the flagellum, this having been previously accomplished by Prof. H. James-Clark, in our own country. It would therefore seem only just, if there were no other reason, that the specific title should be restricted to those colonies with four branches to the main rachis, with a quadrifid subdivision of each into branchlets.

As an appropriate designation for those colonies whose main rachis distally supports three branches, I would suggest the name of the English investigator who has made a special study of the charming members of the order, and propose that the species be known as *Codosiga Kentii*.

It is an interesting fact that the prevailing form in this country, if I may judge from my own observations, is the species with the quadripartite pedicle (Fig. 21, reduced from Kent), while the other obtains in England. In the little pond among the hills of Western New York, where I first saw them, the colonies occurred in abundance. Scarcely a *Lemna* rootlet came to the microscope stage without being ornamented by their crystalline arborescence, while the infinitesimal flagella lashed the water into microscopic whirlpools. Here the bitripartite species occurred so sparingly in proportion, that those with four divisions to the main stem with four branchlets to each formed ninety per cent. of the whole.

Since returning to my home in Trenton, I have observed several fine colonies of the quadripartite form with not only the

main stem but the secondary branches as well, changed from the almost colorless state to the translucent brown tint. The alteration seems to be a favorite one with these exquisite creatures. Since then also, other colonies have been taken which in some important particulars resemble the quadripartite form of *C. umbellata*, but differ in others as essential. The only way to be sure that the observer is studying a mature member of any genus of the Choano-Flagellata is to witness reproductive fission and the departure of the separated moiety. This, I presume, was accomplished by the discoverer of the bitripartite form, or variety, as he considers it. But since Mr. Tatem, in 1868, described the quadripartite foot-stalk as that of an *Epistylis*, it is reasonable to suppose that he did not witness the reproductive act, and that he may therefore have had an immature form of even the quadripartite colony beneath his objective. I am led to this supposition because I have recently obtained, near Trenton, colonies corresponding with the last mentioned in proportionate length of main rachis, in number and arrangement of secondary branches, and in the number of what would be the ultimate subdivisions of the latter; that is, corresponding up to those points at which the zooids would appear and be supported, but having those subdivisions, or branchlets, still further divided, where each, in those noted by myself, gives origin to four other stalks, which thus increase the height of the colony and now act as the immediate supports of the animalcules, only two of the latter being attached to each ultimate stem. The collared infusorians correspond with those of the quadripartite form, the pedicle of which is depicted in figure 21, in shape, size and internal structure, the whole making, as I take it, the complete and mature example of *Codosiga umbellata*. The compound foot-stalk of this form is shown in figure 22.

My hypothesis is further sustained by the fact that in Mr. Tatem's figure of his supposed *Epistylis* four zooids are shown at the extremity of each branchlet, while, as remarked by Kent in reference to his supposed bitripartite variety, the termination of each branchlet bears a considerable number of collared zooids.

The colonies were abundant in the water collected from a shallow pond in the early part of December, 1885, and left standing in a warm room. Their movements are rotary, and comparatively slow.

The species differs from *Desmarella phalanx* (Stein) S. K., the hitherto only known fresh-water form, in the general aspect of the colony, that of the former resembling *D. moniliformis*, S. K., in being composed of zoöids laterally united in long chains. A cluster of the species here described is represented by the diagram shown in figure 11, each little ring there representing one zoöid.

Family SALPINGÆCIDÆ, S. K.

Genus SALPINGÆCA, J. Clk.

SALPINGÆCA AMPHORIDIUM, J. Clk.

SALPINGÆCA STEINII, S. K.

SALPINGÆCA MINUTA, S. K.

SALPINGÆCA GRACILIS, J. Clk.

SALPINGÆCA URCEOLATA, S. K. Pl. III, fig. 18.

Salpingœca urceolata. Stokes: Am. Monthly Micros. Jour., v, Feb., 1884.

The habitat of this species is exclusively marine, according to its discoverer, but in the *American Monthly Microscopical Journal* for November, 1883, the writer recorded its occurrence in fresh water. Since that time the same form has been taken in abundance on *Myriophyllum* from another locality. The differences between the typical salt-water and the fresh-water forms are so slight and the resemblances so many and great that the latter must be considered a *Salpingœca urceolata* with a fresh-water habitat, or at least a sweet-water variety. The resemblance holds good even in the peculiar and characteristic contractility of the lorica neck in the marine form. The differences are the somewhat smaller size of the lorica and the slightly increased length of the pedicle in the fresh-water variety.

SALPINGÆCA ACUMINATA, *Stokes*. Pl. III, fig. 2.

Salpingæca acuminata. Stokes: Am. Monthly Micros. Jour., iv, Nov., 1883.

Lorica vase-shaped, widest at, or immediately behind, the median line, thence posteriorly acuminate and tapering to its junction with the pedicle; anteriorly evenly narrowing to form an everted and somewhat constricted neck, about one-fourth the height of the lorica; pedicle slender, its length once and one-half to twice that of the sheath; the contained zoöid taking the form of the lorica, having an anterior, narrower, neck-like portion, and being somewhat inflated posteriorly when not completely filling the lorica; nucleus anteriorly situated. Lorica $\frac{1}{15000}$, zoöid $\frac{1}{2000}$ of an inch in height. Habitat.—Fresh water, attached to *Myriophyllum*. Solitary, or one or two together.

The species, so far as the shape of the lorica is concerned, resembles the sessilely attached fresh-water *Salpingæca fusiformis*, S. K., but is excluded from the section to which Kent has relegated the latter, by the possession of the pedicle. The likeness of the two forms is made still more conspicuous by the marked tendency of the body-sarcode of each to exude beyond the anterior margin of the lorica. With the animalcule figured it is frequently seen extending in a tongue-like manner into the space bounded by the collar, or projecting as a colorless globule, the collar and flagellum having been absorbed. In several instances a sarcode sphere was formed and remained for an hour or more connected with the zoöid only by a delicate thread, the animalcule to all appearance being about to undergo the reproductive process by transverse fission; but the filament was eventually thickened by flow of protoplasm from the extruded globule, the whole then becoming a lobate projection, which was finally withdrawn into the lorica. This was more than once repeated by the same restless individuals. Although the species does not seem uncommon, one seldom appears with the sarcode filling less than two-thirds of the cavity of the lorica; and often while under observation the animalcule mysteriously increases in sub-

CODOSIGA MAGNIFICA, *Stokes*. Pl. III, fig. 17.

Codosiga magnifica. Stokes: Am. Monthly Micros. Jour., vi, Jan., 1885.

Main stem bearing umbellately eight rigid, straight branches about one-half its own length, and bifurcated, each of the secondary branches subdividing into four branchlets, the summit of each of which usually supports two zoöids resembling in form those of *C. umbellata*; main rachis ten to fifteen, the primary and secondary branches four to six, and the branchlets two to four times as long as the body of a single zoöid. Height of pedicle exclusive of the bodies $\frac{1}{50}$ inch; length of a single body $\frac{1}{1200}$ to $\frac{1}{1500}$ inch. Habitat.—Pond-water, attached to Algæ.

Genus DESMARELLA, *S. K.*

DESMARELLA IRREGULARIS, *Stokes*. Pl. III, fig. 11.

Desmarella irregularis. Stokes: Am. Monthly Micros. Jour., vii, Dec., 1886.

Bodies ovate, constricted beneath the insertion of the membranous collar, somewhat gibbous, scarcely changeable in shape; laterally united into irregular colonies formed of as many as fifty individual zoöids, the external or superior surface usually being unevenly convex and the periphery more or less circular, the clusters frequently separating into smaller companies and remaining temporarily attached through the intermedium of one or more extremely fine filaments; flagellum five or six times as long as the body; contractile vesicles two, opposite, near the centre of the lateral borders; nucleus single, spherical, subcentrally situated; endoplasm granular. Length of body $\frac{1}{2250}$ to $\frac{1}{3000}$ inch. Habitat.—Pond-water. Movements not rapid.

This, the first member of the genus thus far obtained from American waters, is remarkable for several characteristics. Its compound colonies are noteworthy in respect to the number of individual animalcules composing them, as many as fifty having been observed in a single irregularly extended and somewhat convex cluster. The individual zoöids are united either by the

direct contact of their lateral borders at a single point, or through the intermedium of a very short extension on each side of the body. It is probably this usually inconspicuous portion which is drawn out into the fine thread-like extension of the sarcode when the original colony-stock separates in two parts, the filaments eventually breaking, and the clusters then floating independently of each other. These partially separated portions increase the irregular appearance so noticeable in most of the colonies. The flagellum of each zoöid is of extraordinary length, and often distally bulbous.

The change of shape consists chiefly in the assumption of a subspherical contour, after prolonged confinement beneath the cover-glass. At other times the alteration is very slight.

In all the Choano-Flagellata, so far as I am aware, excrementitious fragments are extruded, and food-particles are engulfed at some point within the area surrounded by the base of the collar, the collar itself presenting two distinct currents of its substance, an external upward and an internal downward one, the latter conveying the food-particles directly to the ingestive region. With the present species of *Desmarella*, however, while the excrementitious matters are expelled from the space within the base of the collar, the food is engulfed at a point near the basal attachment of that appendage but external to it, a wave of the body sarcode advancing to receive and surround the adherent morsel. The external current of the collar-like film is here the reverse of that which obtains in the species of the other genera of this order, as is evidenced by the movement which slowly carries the adherent particles downward toward the body, but that the internal flow is upward, as is probable, and almost a necessity under the circumstances, I have not been able to positively see, since the floating materials so soon come within the influence of the whirling flagellum. This peculiarity in food habit is an important and interesting characteristic of this species at least; it is probably an unobserved custom in all the members of the genus.

by means of a posteriorly developed pedicle, those two being *Salpingoeca petiolata*, S. K., and *S. Clarkii*, Stein. In the latter, however, the thread-like prolongation is not constant, those individuals possessing it being considered abnormal or varietal.

Thus far but a single individual of the species here referred to has been observed. It is delineated in figure 12.

Family PHALANSTERIIDÆ, S. K.

Genus PHALANSTERIUM, Cienk.

PHALANSTERIUM CONSOCIATUM, (Fres.) Cienk.

Phalansterium consociatum. Stokes: *The Microscope*, iv, May, 1884.

PHALANSTERIUM DIGITATUM, Stein.

Phalansterium digitatum. Stokes: *Science*, Oct. 13, 1883; *The Microscope*, iv, May, 1884.

Genus PROTEROSPONGIA, S. K.

PROTEROSPONGIA PEDICELLATA, Oxley.

Proterospongia pedicellata. Stokes: *The Microscope*, vi, May, 1886.

ORDER DINO-FLAGELLATA, Bütschli.

SUB-ORDER DINIFERA, Bergh.

Family PERIDINIIDÆ, Bergh.

Genus PROTOPERIDINIUM, Bergh.

PROTOPERIDINIUM LIMBATUM, Stokes. Pl. IV, fig. 1.

Protoperidinium limbatum. Stokes: Proc. Am. Phil. Soc., xxiv, No. 126, 1887.

Carapace rhomboidal, depressed, little longer than broad, the postero-lateral margins produced into two, short, acuminate, horn-like processes, the posterior border concave; ventral surface flattened; with a central, longitudinal depression; surface faceted and minutely reticulated, the margins of the carapace and of the equatorial groove having a narrow, colorless, projecting, flattened and reticulated border; flagellum of the lateral groove spiral. Length $\frac{1}{300}$ inch. Color yellow. Habitat.—Marsh-water, with *Sphagnum*.

Genus PERIDINIUM, Ehr.

PERIDINIUM TABULATUM, (Ehr.) S. K.

Peridinium tabulatum. Stokes: Jour. Trenton Nat. Hist. Soc., Jan., 1886.

The rather startling discovery that there are no cilia in the transverse groove, where, ever since Ehrenberg wrote in 1836, they have been described as important organs, was recently announced by Klebs and subsequently confirmed by Bütschli. This necessitated a division of Claparede and Lachmann's group of Cilio-Flagellata, and the formation of the Dino-Flagellata, which was done by Bütschli. The tendency is to entirely destroy the Cilio-Flagellata under the supposition that all forms hitherto grouped together under that order are in reality destitute of cilia, and in possession of flagella only. Indeed, in the latest published complete classification of the Infusoria, that of Prof. E. Ray Lankester, in the ninth edition of the *Encyclopædia Britannica*, no mention is made of the Cilio-Flagellata, Bütschli's Class Dino-Flagellata alone being noticed and adopted. In reference to the *Peridinium uberrimum* of Allman (*Melodinium uberrimum*, (Allman) S. K.), Prof. Lankester says: "The hair-like processes figured by Allman external to the transverse groove in his *Peridinium uberrimum* cannot, however, be explained as a flagellum. Bütschli inclines to the opinion that their nature was misinterpreted by Allman, although the latter especially calls attention to them as cilia, and as rendering his *P. uberrimum* unlike the *Peridinium* of Ehrenbergh, in which the cilia (horizontal flagellum) are confined to the transverse groove." It seems scarcely probable that Prof. Allman could have misinterpreted these cuticular appendages, when he distinctly asks attention to them as vibratile. However, the writer has discovered and repeatedly observed an infusorian (*Am. Jour. Sci.*, Aug., 1884,) to which the new generic title *Ileonema* has been given. This form has its entire cuticular surface rather sparingly clothed with long, fine, and somewhat independently vibrating cilia, and in addition, possesses an anterior, special

stance until it bubbles over in front, and at times even occupies the posterior hollow acumination.

SALPINGŒCA LAGINELLA, *Stokes*. Pl. III, fig. 15.

Salpingœca lagina. Stokes: Am. Monthly Micros. Jour., vi, Jan., 1885.

Lorica pedicellate, flask-shaped, subglobose and inflated posteriorly, attached to the pedicle by the evenly rounded base, and produced anteriorly into a cylindrical neck everted at its distal extremity; the enclosed zoöid taking the form of the lorica and often completely filling it; contractile vesicles, two or more, posteriorly placed and conspicuous; pedicle slender, straight, twice to two and one-half times as long as the lorica. Length of lorica $\frac{1}{2500}$ inch. Habitat.—Attached to various Algæ and aquatic plants from ponds in New Jersey. Solitary.

This form resembles *Salpingœca amphoridium*, J. Clk., lifted on a long foot-stalk, and differs from all known pedicellate species in the evenly rounded contour of the lorica base. It has thus far been met with only in one locality, a small pond to which there is no visible outlet, whose surface is densely covered by *Lemna polyrrhiza*, to whose rootlets, and to the net-work of the veins of decaying leaves the loricae are sparingly attached.

SALPINGŒCA EURYSTOMA, *Stokes*. Pl. III, fig. 14.

Salpingœca eurystoma. Stokes: Am. Monthly Micros. Jour., vii, Dec., 1885.

Lorica vase-shaped, about one and one-half times as long as broad, somewhat inflated centrally, thence tapering posteriorly to the pedicle; anteriorly constricted, and thence rapidly expanding to the aperture, which forms the widest part, its margins strongly and conspicuously everted; pedicle subequal to the lorica in length; enclosed animalcule ovate or subpyriform, occasionally connected with the lorica by a fine posteriorly developed ligament; contractile vesicles, two. Length of lorica $\frac{1}{2600}$ inch; width of the anterior aperture $\frac{1}{3000}$ inch. Habitat.—Pond-water; on filamentous Algæ or other fine vegetable fibres. Solitary or scattered.

Five individuals of this easily recognizable species have been observed attached at almost equidistant points to a vegetal fibre. These constitute the entire number thus far noticed, and even these few seem somewhat variable in two characters. With two individuals the enclosed zoöid was connected with the lorica by a posteriorly developed ligament; in one the lorica was at its hindmost border so suddenly tapered that the pedicle seemed a delicate solid stem, while in the remaining four the lorica was apparently continued for about one-half the entire length of the stem by means of a hollow gradually narrowing foot-stalk. As this was the prevailing condition in the few observed, it is shown in the figure.

SALPINGÆCA SPHERICOLA, Stokes. Pl. III, fig. 12.

Salpingæca sphericola. Stokes: Am. Monthly Micros. Jour., vi, Jan., 1885.

Lorica pedicellate, ovate or subglobose, truncate anteriorly, the margin not everted, posteriorly rounded and somewhat narrowed at its junction with the pedicle; enclosed zoöid ovoid, slightly constricted beneath the anterior margin, posteriorly inflated, occupying the centre of the lorica and attached to it through the intermedium of a thread-like, non-contractile ligament one-half its own length; collar long and narrow, somewhat more than one-half its length projecting beyond the aperture of the lorica; pedicle straight, rigid, equal or subequal to the lorica in height. Length of lorica $\frac{6}{10000}$ inch, greatest width $\frac{5}{10000}$ inch. Habitat.—Attached to rootlets of *Lemna*, in shallow ponds in Western New York. Solitary.

When disturbed, especially when irritated by tapping the cover-glass with a needle, the body of the animalcule within the lorica quickly contracts into a spherical form balanced on the summit of the secondary pedicle within the sheath, after which it slowly resumes its normal outlines and protrudes the collar to the normal distance into the surrounding water.

Excepting this species, but two others have thus far been recorded in which the enclosed zoöid is connected with the lorica

Family TRICHONEMIDÆ, S. K.

Genus ILEONEMA, Stokes.

Body flask-shaped, depressed, elastic, entirely ciliate; flagellum single, inserted at the narrow anterior extremity, the basal half large, thick and apparently twisted, the distal half fine, thread-like; oral aperture terminal, perforating the apex of the neck-like portion; pharynx distinct; nucleus subspherical or broadly ovoid, subcentral; contractile vesicle posteriorly placed; anal aperture postero-terminal.

ILEONEMA DISPAR, Stokes. Pl. IV, fig. 2.

Ileonema dispar. Stokes: Am. Jour. Sci., Aug., 1884. The Microscope, Jan., 1885.

Body transparent, flexible, flask-shaped, longitudinally striate, the length about three times the breadth, contracting to a short ovoid form or extending until clavate; the ventral surface flattened, the dorsal convex and bearing a single central, longitudinally disposed row of short hair-like perpendicular setæ; cilia long and fine, thinly clothing the surface; entire flagellum one-half the length of the body, the basal half thick, obliquely grooved and presenting a twisted or cord-like appearance, slightly tapering yet suddenly constricted at the beginning of the finely filamentous distal one-half; oral aperture at the base of the flagellum; pharynx elongate-fusiform, longitudinally plicate, apparently composed of delicate, elastic, rod-like elements; nucleus ovoid, subcentral; contractile vesicles two, postero-terminal, close to the anal aperture. Length of body $\frac{1}{200}$ inch. Habitat.—Among Algæ and decaying leaves at the bottom of shallow pools.

This bottle-shaped infusorian was taken from among those delicate Algæ which grow so abundantly in all quiet waters, and seem to cling like soft green clouds to leaves of grass and fragments of sticks and twigs in the shallow wayside pools of early spring. Its movements are evenly swimming without rotation and without much hurry. Its changes of form are, however,

quite constant as it rests among the algal threads and lengthens the entire body into a club-shaped creature searching for food, or contracts into an egg-shape with a short, narrow neck. Normally its contour closely resembles that of *Trachelophyllum apiculatum* (Perty), C. & L. If, from the latter, the acutely conical anterior apex be removed, and the flagellum of *Ileonema* be added, the result would be a species of the genus now under notice, the likeness between the contracted forms being also striking.

The fine long cilia are not abundant. They vibrate irregularly and, to a certain extent, independently of each other. The infusorian seems to swim by their aid alone.

The distal one-half of the flagellum is extremely fine, and is often absent, as indeed is the entire appendage of individuals kept long in confinement. When the filamentous portion has been lost, the cord-like half frequently ends in a bulbous enlargement, and even this the animalcule often loses, apparently without injurious results. This bulb seems to be adhesive; it at least easily attaches itself to foreign bodies, and I have witnessed its owner, after several attempts, forcibly tear itself loose and lose the bulb. The whole flagellum is generally carried trailing and curved to one side, occasionally being extended and used apparently as a feeler. When the flagellum has been lost, the infusorian possesses no character to distinguish it from the *Holotricha* of Stein, and if first met with in this condition any observer would classify it in that order.

I was at first disposed to consider the pharynx a membranous tube whose walls are thrown into longitudinal folds, but such interpretation was precluded by further observation. The passage is very dilatable, and the infusorian has the habit of widely expanding the posterior or internal extremity, as the body assumes the ovate form, when folds would become extinct and rods or fibrillæ more conspicuous, which is, in fact, the case. That an elastic membrane connects the rod-like constituents of the passage, I have not been able to determine. My impression,

vibratile flagellum of rather peculiar structure. The cuticular appendages are vibratile, and they are cilia; and the flagellum is, furthermore, a true flagellum, although, as already stated, of somewhat peculiar if not unique structure. In this instance both kinds of appendage come within the definition published by the latest authority on the subject, Prof. E. Ray Lankester, in the *Encyclopædia Britannica*: "A flagellum may be said to be an isolated filament of vibratile protoplasm, whilst a cilium is one of many associated filaments of the kind. The movement, however, of a flagellum is not the same as that of any cilium; and the movement of all flagella is not identical. A cilium is simply bent and straightened alternately, its substance probably containing, side by side, a contractile and an elastic fibril. A flagellum exhibits lashing movements, to and fro, and is thrown into serpentine waves during these movements." *Ileonema* is not a member of the Dino-Flagellata; neither is the *Melodinium* (*Peridinium*) *uberrimum* of Allman. They are excluded by the definition of the Class: "Corticate Protozoa of a bilaterally asymmetrical form, sometimes flattened from back to ventral surface, sometimes from the front to the hinder region, sometimes from right to left, the anterior region and ventral surface being determined by the presence of a longitudinal groove and a large flagellum projecting from it. In all except the genus *Prorocentrum* there is as well as a longitudinal groove a transverse groove (hence Dinifera) in which lies horizontally a second flagellum (Klebs and Bütschli), hitherto mistaken for a girdle of cilia." They are furthermore excluded (this is the case with *Ileonema* at least) by the undoubted presence of undoubted cuticular cilia clothing the general surface. If the Cilio-Flagellata as an order is to be discarded, what is to be done with *Ileonema*? As long as *Ileonema* exists, so long must the Cilio-Flagellata, as a group of Infusoria, remain, in some form at least, to include it.

There is no doubt as to the presence of a flagellum in the horizontal groove of certain Infusoria. In the form referred to

under the title *Peridinium tabulatum*, the transversely-directed appendage can be studied with comparative ease by means of a Spencer homogeneous immersion one-tenth inch objective, after the infusorian has been weakened by prolonged confinement beneath the cover-glass, and the movements of the flagellum have therefore become less rapid than in health. It then presents the aspect of a long spiral coil lying in the depression, rotating on its longitudinal axis, and extending around the body from the right-hand side of the longitudinal groove toward the left-hand side for about three-fourths of the entire circumference of the infusorian. Among the numerous specimens examined I have been unable to obtain one in which the spiral flagellum made the entire circuit of the body and appeared on the left-hand side of the ventral portion of the transverse groove.

Genus CERATIUM, Schrank.

CERATIUM HIRUNDINELLA, (Müll.) Bergh.

Observed by Mr. A. H. Breckenfeld in the water-supply of San Francisco, and in that of New York City by Prof. Romyn Hitchcock. (*Am. Monthly Micros. Jour.*, v, Jan., 1884.)

ORDER CILIO-FLAGELLATA, C. & L.

Family HETEROMASTIGIDÆ, S. K.

Genus HETEROMASTAX, J.-Clk.

HETEROMASTAX PROTEIFORMIS, J.-Clk.

So far as I am aware this infusorian has been observed only by its discoverer, Prof. H. James Clark.

Family STEPHANOMONADIDÆ, S. K.

Genus ASTHMATOS, Salisbury.

ASTHMATOS CILIARIS, Salisbury.

Asthmatos ciliaris. Cutter: *Virginia Medical Monthly*, Nov., 1878; *Am. Jour. of Micros.*, March, 1881.

Asthmatos ciliaris. Leidy: *Am. Jour. Med. Sci.*, Nov., 1880.

through the influence of the glycerole of tannin, the distal end of each, for about one-tenth of the entire length, is conspicuously thickened, so that the trichocyst seems to be supplemented by the addition of a minute pyramid (figure 5). Occasionally, before the animalcule's death, when suffering from the application of a very dilute solution of the glycerole, it then gradually assuming an evenly ovoid form and becoming pale and ghostly, and always after the extrusion of the trichocysts and their removal from the body, the cuticular elevations are replaced by equally minute, regularly disposed, parallelogrammic depressions, as if the escaping trichocysts had left empty spaces which were filled by the sinking of the cortex. The nucleus and nucleolus are not always constant either in relation to each other or to a special part of the body. The former is sometimes, and normally it would seem, subcentrally located, yet sometimes being near the dorsum, again nearest the ventral surface, and still again in the anterior extremity, being seldom seen behind the body-centre. The laterally attached nucleolus is almost as uncertain in its relative connection with the nucleus, becoming at times entirely detached.

Conjugation has been observed, union taking place between the latero-ventral surfaces. Reproduction is by transverse fission, the nucleus previously becoming much elongated, the dividing plane passing through its centre. In some instances, soon after the beginning of genetic union, the nucleus assumes a finely striated appearance, gradually growing more and more indistinct in contour until it finally becomes indistinguishable from the surrounding endoplasm.

Family PRORODONTIDÆ, S. K.

Genus PRORODON, Ehr.

PRORODON LIMNETIS, Stokes. Pl. IV, fig. 6.

Prorodon limnetis. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Body ovate, subcylindrical, soft and flexible, twice as long as broad, slightly curved toward one side anteriorly, the lateral

borders gently concave, both extremities rounded; cuticular surface longitudinally striate, finely and entirely ciliate; oral aperture eccentric, the oral cilia more conspicuously and abundantly developed than those of the general surface; pharyngeal passage a conical rod-fascicle extending to near the body-centre; contractile vesicle single, spherical, postero-terminal, frequently leaving, after systole, a number of small, spherical vacuoles; nucleus ovate, laterally placed in the posterior body-half; endoplasm semi-opaque by the inclusion of numerous dark corpuscles. Length of body $\frac{1}{200}$ inch. Habitat.—Standing water, with decaying vegetation, from the cypress swamps of South Florida.

This form seems to most nearly approach *P. teres*, Ehr., differing from it chiefly in the somewhat eccentric position of the oral aperture in the well-marked antero-lateral curvature, and the slight but noticeable concavity of the lateral borders. The movements are rotary on the longitudinal axis.

HOLOPHRYA ORNATA, Stokes. Pl. VI, fig. 13.

Holophrya ornata. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body obovate, compressed, slightly curved toward one side, less than three times as long as broad, the anterior extremity rounded, the posterior truncate; cuticular surface not striate, entirely ciliate, the cilia long and fine; oral aperture eccentric, the borders slightly protruding; lateral margins and posterior extremity ornamented by two rows of cuticular, rounded elevations, the series beginning at the middle third of one lateral border, and continued through the middle third of the opposite region, the constituent elevations of one series being alternate with those of the other; contractile vesicle single, large, near the posterior extremity; nucleus obscure; endoplasm coarsely granular. Length, about $\frac{1}{250}$ inch. Habitat.—Standing pond-water. Movements rotatory on the longitudinal axis.

however, is that none exists, the pharynx being merely an elongated cage-like structure open at each end, its delicate bars attached only around the oral aperture.

CLASS II, CILIATA, *Ehr.*

ORDER HOLOTRICHA, *Stein.*

Family PARAMÆCIIDÆ, *S. K.*

Genus PARAMÆCIUM, *Müll.*

PARAMÆCIUM AURELIA, *Müll.* Pl. IV, fig. 3.

Paramæcium aurelia. Stokes: The Microscope, iv, June, 1884.

There are two varieties of this infusorian, the two differing in the presence or absence of a brush-like tuft of cilia terminating the posterior extremity of the body. The statement is made by Saville Kent (*Manual of the Infusoria*) that, although Claparede and Lachmann delineate this postero-terminal tuft as conspicuously developed, he regards its presence as "signalizing a well-marked local modification, but certainly not the predominant type of this cosmopolitan species." May not the absence of the brush-like tuft signalize the local variety? May not the smooth-tailed *Paramæcium* be the variety common to English waters? According to my observation, it is not the common American form. All those so abundant in the writer's locality, as well as the numerous specimens recently examined from a distant region (Northern New York), possess this posterior appendage beautifully developed. Indeed, the writer has never seen a *Paramæcium aurelia* without it. Prof. D. S. Kellicott, however, reports the smooth-tailed variety as not uncommon in Western New York. (*Proc. Am. Soc. Microscopists*, 1884.)

PARAMÆCIUM BURSARIA, (*Ehr.*) *Fooke.*

PARAMÆCIUM TRICHIUM, *Stokes.* Pl. IV, figs. 4 and 5.

Paramæcium trichium. Stokes: Am. Natural., xix, May, 1885.

Body soft and flexible, ovate, somewhat compressed, three times as long as broad, widest and slightly inflated posteriorly, both extremities rounded, the ventral surface somewhat flattened; adoral fossa extending to the centre of the ventral aspect from

the left obliquely toward the right, deepest and widest anteriorly, this part of the body apparently folded obliquely toward the left-hand side; oral aperture followed by a distinct, tubular, ciliated, pharyngeal passage; trichocysts abundant, arranged vertically and apparently elevating the cuticular surface into the numerous, parallel, longitudinal series of minute hemispherical projections roughening the entire body and giving it, in optical section, a crenulated outline, their distal extremities, when forcibly extruded, conspicuously and pyramidally thickened; nucleus ovate, usually subcentrally placed, with a laterally attached nucleolus; contractile vesicle double, spherical, anteriorly located; anal aperture ventro-terminal. Length of body $\frac{1}{300}$, of trichocysts $\frac{1}{1000}$, inch. Habitat.—In the jelly-like mass of fungoid and bacterial growth on the surface of an infusion of dead leaves.

When the growth of fungi and bacteria on the water was near its height, a *Paramœcium* appeared in profusion. It seems to be a distinct species, and one that can scarcely be mistaken for any known form, except possibly for *P. bursaria* (Ehr.) S. K., differing from the latter, however, conspicuously in form, especially in the apparently oblique curvature of the anterior extremity, in the absence of the truncation of the same part, the absence of the rapid and continuous circulation of the endoplasmic contents, and particularly the green coloration of the cortex and sarcode. The oral aperture of the form I have named *Paramœcium trichium* is at the posterior extremity of the deep adoral fossa, which gives the front part the appearance of being folded toward the left, and is followed by a distinct, ciliated pharynx. The two contractile vesicles, instead of being placed one in each body-half, as in *P. bursaria*, are here anterior and close together, contracting quickly, the one beginning to again form almost before the completion of the other's systole. Trichocysts are very abundant, and are so arranged that they seem to elevate the cuticular surface into the minute hemispherical bosses that cover the entire body. When forcibly extruded

Genus DEXIOTRICA, Stokes.

Animalcules free-swimming, persistent in shape, entirely ciliate, elongate-ovate or subreniform, rounded posteriorly; oral aperture ventral, followed by a short, entirely ciliated pharyngeal passage; one or more fine, hair-like setæ projecting from the posterior extremity of the body, and a single series of flexible, setose cilia extending transversely and obliquely across the anterior, right-hand lateral and ventral borders from the margin of the oral aperture to the margin of the dorsal surface; nucleus ovate; contractile vesicle single; anal aperture posteriorly situated. Trichocysts present.

DEXIOTRICA PLAGIA, Stokes. Pl. IV, fig. 7.

Deziotricha plagia. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body elongate-ovate, two and one-half to three times as long as broad, the entire surface bearing minute, hemispherical protuberances, which give the infusorian, in optical section, a crenulated outline; both extremities rounded, the posterior widest, the anterior one slightly curved toward the ventral aspect, the anteriorly-placed ventral concavity thus formed occupied by the ovate oral aperture; pharyngeal passage short, slightly recurved, its cilia projecting beyond the oral aperture; cilia of the general surface setose; a single series of flexible, somewhat curved, setose cilia extending from the right-hand margin of the oral aperture obliquely backward and transversely across the right-hand side of the anterior body-half to the border of the dorsal surface; a single, long, often distally curved seta projecting from the posterior extremity; nucleus broadly ovate, subcentrally placed; contractile vesicle single, spherical, situated on the right-hand side of the posterior body-half near the ventral surface; endoplasm enclosing numerous, small, apparently bi-concave corpuscles; anal aperture ventral, near the posterior extremity. Length of body $\frac{1}{400}$ inch. Habitat.—Standing pond-water, and vegetable infusions. Conjugating by a union of the anterior portion

of the ventral surfaces, apparently including the oral apertures. Reproduction by transverse fission.

The object of this remarkable, one-sided arrangement of the adoral setæ is to direct food particles to the oral aperture. When the infusorian is quietly feeding, the cilia of the general cuticular surface are all quiescent, with the exception of those on the right-hand side in advance of the adoral, lateral hedge of setose bristles. They alone being in motion, the currents which they produce carry the food particles against the stiffly upheld cilia, whose obliquely directed course turns the stream downward and forward to the oral aperture.

DEXIOTRICHA CENTRALIS, Stokes. Pl. IV, fig. 11.

Dexiotricha centralis. Stokes: Am. Monthly Micros. Jour., vi, Oct., 1885.

Body elongate-subreniform or bean-shaped, longitudinally striate, about twice as long as broad, widest posteriorly, both extremities rounded; dorsal surface convex, ventral aspect anteriorly concave; oral aperture ovate, situated somewhat in advance of the centre of the ventral surface; pharyngeal passage short, recurved; cilia long and fine, those of the posterior extremity longest and most setose; caudal seta single, subequal to the body in length; adoral setæ fine, adcurved, extending in a single row obliquely across the right-hand lateral border, from a point posterior to the centre of the dorsal surface to near the centre of the right-hand margin of the oral aperture; endoplasm colorless, granular, transparent; nucleus not observed; contractile vesicle single, spherical, near the posterior extremity. Length of body $\frac{1}{700}$ inch. Habitat.—Stagnant pond-water, with *Lemna* and other aquatic plants. This is readily distinguished from *D. plagia* by the more posterior position of the adoral setæ and of the contractile vesicle, by the much greater proportionate length of the caudal seta, but especially by the entire absence of the apparently bi-concave corpuscles so abundantly present within the endoplasm of *D. plagia*.

As is usually the habit with the last-named form, *D. centralis*,

when taking food, rests upon one side, the cuticular cilia in the rear of the adoral setæ then being comparatively quiescent, while those clothing the frontal region are in the most active movement, the currents thus produced, in both species, carrying the food-particles against the oblique setose hedge, which deflects them toward the mouth.

Family TRACHELOPHYLLIDÆ, S. K.

Genus TRACHELOPHYLLUM, C. & L.

TRACHELOPHYLLUM TACHYBLASTUM, Stokes. Pl. IV, fig. 9.

Trachelophyllum tachyblastum. Stokes: Am. Monthly Micros. Jour., v, July, 1884.

Body elongate, flattened, flask-shaped when contracted, clavate when extended, eight to ten times as long as broad; neck slender, equalling about one-third of the length of the entire body, the annular apical constriction obtusely rounded; pharyngeal passage indistinct, narrow, longitudinally striate; cuticular surface thinly clothed with cilia which vibrate somewhat independently and irregularly; contractile vesicle single, near the posterior extremity, forming quickly after systole by the coalescence of small vacuoles; nuclei two, spheroidal, subcentral; anal aperture postero-terminal. Length of extended body $\frac{1}{167}$ to $\frac{1}{200}$ inch. Habitat.—Among the decaying detritus at the bottom of shallow pools.

This little creature swims evenly and smoothly, like the other members of the genus, without revolving, but rapidly and in a headlong way. Its hasty movements were the cause of an accident, the result of which suggested the specific name. A collision occurred between it and a large *Oxytricha platystoma*, Ehr., followed by a whirl and a dash that momentarily carried both out of the field. In less than a second the *Trachelophyllum* was again under the lens, but it seemed bewildered, floating apparently without effort, having contracted itself. It was bleeding copiously, for the whole apical constriction and the entire pharyngeal tract had been snapped off, and the endoplasm was

streaming from the wound in threads and globules and granular particles. Almost immediately, however, the exudation of protoplasm ceased; in less than two minutes another constricted apical ring was formed, in less than fifteen minutes a new pharynx was produced, and the hardy little infusorian extended its shortened body and hurried off in the same hasty way as if nothing unusual had happened.

In its contour it resembles *T. pusillum*, C. & L., differing chiefly in the larger size, being from three to four times greater, and in the more spherical form of the nuclei.

TRACHELOPHYLLUM CLAVATUM, Stokes. Pl. IV, fig. 8.

Trachelophyllum clavatum. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Body elongate, flask-shaped or subclavate, somewhat flattened, five to six times as long as broad, elastic and flexible, the neck-like anterior portion scarcely distinguishable from the body proper; cilia vibrating irregularly and somewhat independently; oral aperture terminal; pharynx an obconical fascicle of fine rod-like elements, extending through the anterior one-third of the body; nucleus single, ovate, subcentral; contractile vesicle single, spherical, postero-terminal, frequently leaving two or more smaller vacuoles after systole; endoplasm granular. Length of body $\frac{1}{125}$ inch. Habitat.—Standing water on decaying vegetation from South Florida.

The animalcule's movements are rather slow and smoothly gliding, with frequent bending and curving of the anterior region as the creature searches heaps of detritus for food. The pharyngeal fascicle is distinct even during life, but after death by iodine-poisoning, the body becomes diffuent and the pharynx floats out as a disarranged cluster of extremely fine hair-like rods. There seems to be no connecting membrane. During life the infusorian has the power, which it frequently exercises, of expanding the posterior portion of the fascicle and thus apparently separating the constituent rods. After death the latter

become entirely free, except at the anterior points of attachment around the oral aperture. The species is the only one thus far recorded with a single nucleus.

TRACHELOPHYLLUM VESTITUM, Stokes. Pl. IV, fig. 10.

Trachelophyllum vestitum. Stokes: Am. Monthly Micros. Jour., v, July, 1884.

Body elongate, flask-shaped, much flattened, very extensile and elastic, the length from four to five times the breadth; neck somewhat fusiform, about one-half the body in length, the apical constriction truncate, somewhat dilated distally; the entire surface, except the apical constriction, invested by a mucilaginous, structureless or finely granular coating whose depth equals about one-third the entire length of the cuticular cilia, the latter being fine, thinly clothing the body in longitudinal rows, their action somewhat independent and irregular, only that portion of each cilium vibrating which extends beyond the mucilaginous investment; pharyngeal tract distinct, finely striate longitudinally; nuclei two, ovate, one nodule located in the anterior, the other in the posterior body-half; contractile vesicle single, posteriorly placed, quickly forming after systole by the union of several vacuoles, which often become visible just previous to the pulsation; anal aperture postero-terminal; trichocysts (?) abundant, acicular, scattered and collected in fascicles. Length of body $\frac{1}{100}$ inch. Habitat.—The surface of submerged and water-soaked objects at the bottom of shallow ponds.

The body contains needle-shaped objects scattered throughout its substance and collected in obliquely disposed bundles, deeper, apparently, than the cortical layer. They may be trichocysts, but their form and the action of the light suggest that they may be crystals. They closely resemble the acicular raphides so abundant in *Lemna*, *Tradescantia* and other common plants. The solution of tannic acid in glycerin has no visible effect upon their position.

Genus UROTRICHA, C. & L.

UROTRICHA PLATYSTOMA, Stokes. Pl. IV, fig. 12.

Urotricha platystoma. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body oval or somewhat obovate, less than twice as long as broad, subcylindrical, entirely ciliate, the cilia vibrating irregularly and independently, shortest and least numerous on the posterior border; cuticular surface conspicuously ornamented by minute hemispherical elevations arranged in longitudinal series; oral aperture apical, the margins slightly protruding, giving it a pouting aspect; posterior springing-hair shorter than the body, obliquely directed, its distal extremity usually curved; contractile vesicle single, spherical, near the lateral border of the posterior extremity; anal aperture postero-terminal, near the pulsating vacuole. Length of body $\frac{1}{660}$ inch. Habitat.—Standing water, with *Sphagnum*; movements rotatory, and leaping by means of the posterior seta. Reproduction by transverse fission.

The oral aperture is enormously expansile. An individual has been seen attempting to engulf the empty lorica of *Trachelomonas volvocina*, Ehr., expanding the oral orifice to an extent nearly equalling the diameter of the spherical shell. The position of the anal aperture has not been previously observed in the species of this genus.

Family COLEPIDÆ, Ehr.

Genus COLEPS, Ehr.

COLEPS HIRTUS.

Family ENCHELYIDÆ, S. K.

Genus PERISPIRA, Stein.

PERISPIRA STREPHOSOMA, Stokes. Pl. IV, fig. 13.

Perispira strephosoma. Stokes: Am. Monthly Micros. Jour., vii., May, 1886.

Body elongate-ovate, often somewhat curved toward the right-hand side, about four times as long as broad, bearing a ridge-like elevation extending as a single long spiral from the left-hand

corner of the obliquely truncate anterior border to the evenly rounded posterior extremity, the cilia on each side of the spiral elevation long, fine, and arranged in a single series; contractile vesicle single, spherical, postero-terminal; nucleus ovate, near the centre of one lateral border; oral and anal apertures not observed; endoplasm crowded with small, oblong, dark-bordered corpuscles. Length $\frac{1}{300}$ inch. Habitat.—Standing water, with *Sphagnum*. Movements rotary on the longitudinal axis.

The cilia of the general cuticular surface are very fine and extremely difficult to see when the infusorian is swimming; only when weakened by prolonged confinement beneath the cover-glass, or when dying from the effects of dilute solution of perchloride of iron, can the observer positively determine their existence.

Genus COLPODA, Ehr.

COLPODA DEPRESSA, Stokes. Pl. IV, fig. 14.

Colpoda depressa. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, Nov., 1886.

Body ovate, depressed, less than three times as long as broad, slightly widest anteriorly, the frontal border rounded, the right-hand side of the posterior margin slightly and obliquely truncate, the right-hand body-margin somewhat flattened, the left-hand side convex; ventral surface flattened, slightly concave; cilia of the posterior border longest and most conspicuous, a single cilium occasionally longer than the others; oral aperture ventral, in the anterior body-half, on the right-hand side of the median line; the projecting ciliary tuft broad, the cilia fine and appearing like an undulating membrane; contractile vesicle single, spherical, in the posterior body-half on the right-hand side of the median line; the cuticular surface roughened by minute elevations arranged in longitudinal rows, except in the oral region, where a long obovate space is comparatively smooth; endoplasm colorless, granular; trichocysts numerous, arranged perpendicularly to the cuticular surface; nucleus ovate, subcentrally located; anal aperture ventral, on the right-hand side of

the posterior extremity. Length of body $\frac{1}{300}$ to $\frac{1}{450}$ inch. Habitat.—Standing water, with *Sphagnum*. Reproduction by transverse fission.

The most recently formulated generic diagnosis of *Colpoda* refers to the oral aperture as situated in a cleft-like fissure, that orifice in the present form not being so placed but on the flattened ventral surface. It would therefore seem preferable to slightly modify the generic description so as to include the present infusorian, rather than to form a new generic title upon a difference so slight, especially since the other essential characters are undoubtedly similar. In the previously known species trichocysts have not been observed, neither has the position of the anal aperture been recorded.

Genus *TILLINA*, Gruber.

TILLINA HELIA, Stokes. Pl. IV, fig. 15.

Tillina helia. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body somewhat bean-shaped, or subelliptical, with an anteriorly situated ventral concavity; twice as long as broad, slightly widest posteriorly, longitudinally striate, and entirely ciliate, the cilia of the posterior extremity longest and most conspicuous, the anterior and posterior borders evenly rounded, the former somewhat curved toward the ventral aspect; oral aperture elongate-ovate, obliquely set within the anterior ventral concavity, followed by a short, recurved ciliated pharynx; contractile vesicle single, situated back of the body-centre near the right-hand lateral border, often leaving, after systole, a rosette of small vacuoles, which finally coalesce; anal aperture ventral, near the posterior extremity; nucleus large, ovate, subcentrally situated. Length of body $\frac{1}{300}$ inch. Habitat.—Standing water, with Algae.

Although the nucleus is correctly referred to as being subcentrally placed, its position in reference to any special region is not constant. At times it is near and central to the dorsum, at others it is almost exactly in the centre of the body, and occa-

sionally it is to be found near the middle of the ventral surface. The majority of individuals examined had this important organ as shown in the figure (Pl. IV, fig. 15), where it would seem to be in its normal position.

TILLINA FLAVICANS, Stokes. Pl. IV, fig. 16.

Tillina flavicans. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body subreniform or bean-shaped, soft and flexible, but persistent in form, minutely roughened and obliquely striate, the anterior and posterior extremities subequal in width, the anterior body-half compressed; oral aperture ovate, obliquely placed near the centre of the right-hand border of the ventral surface; pharyngeal passage long, recurved, entirely ciliate; contractile vesicle single, spherical, on the left-hand margin near the posterior extremity; nucleus spherical, subcentrally located; anal aperture postero-terminal. Length of body $\frac{1}{500}$ to $\frac{1}{600}$ inch. Habitat.—An infusion of dead leaves.

The animalcule's movements are rapidly forward in straight lines or in irregular spirals, commonly with one side or the other downward. The food-particles are usually collected in conspicuous spherical masses, which are carried around the body in a quite constant endoplasmic current. The color, usually a shade of brown, varies considerably, probably being affected by the color of the infusion in which the animalcule thrives.

TILLINA CAMPYLA, Stokes. Pl. IV, fig. 20.

Tillina campyla. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body elongate-ovate, entirely ciliate, soft, flexible, about three times as long as broad, widest and rounded posteriorly, the anterior extremity recurved towards the ventral surface, the ovate oral aperture placed in the ventral concavity thus formed; cuticular surface longitudinally striate; pharynx short, recurved, the roof bearing a series of fine cilia, longest anteriorly, and projecting beyond the oral aperture; contractile vesicle single,

spherical, posteriorly placed near the ventral surface; nucleus single, subspherical, and subcentral. Length of body $\frac{1}{460}$ inch. Habitat.—Standing water, with dead leaves. Movements rapid.

The pharyngeal ciliation seems to be confined to the superior wall or roof. The cilia are very fine, and usually vibrate synchronously, thus presenting so close a resemblance to an undulating membrane, that their character can be satisfactorily determined only when the infusorian is in a dying condition.

TILLINA SAPROPHILA, Stokes. Pl. IV, figs. 21 and 22.

Tillina saphrophila. Stokes: Am. Natural., Feb., 1884.

Body flexible, obliquely grooved, subreniform or bean-shaped in profile, length once and one-half to twice the width; when viewed dorsally, ovate, wider and somewhat inflated posteriorly, tapering and pointed anteriorly; size and dorsal convexity increasing, the ventral concavity lessening with age, thus giving the mature animal an almost semicircular outline when seen laterally; cuticular surface entirely ciliate, the cilia somewhat larger anteriorly; oral aperture circular, placed centrally in the ventral surface and followed by a short, recurved, membranous pharynx entirely ciliate within; endoplasm enclosing colorless corpuscles and dark-bordered linear bodies; nucleus spherical, dorso-central; contractile vesicles several or single, posteriorly situated; anal aperture not observed. Length of body $\frac{1}{1000}$ to $\frac{1}{750}$ inch. Habitat.—The putrid liquid of animal macerations made with water from the Delaware river.

The likeness of *Tillina magna*, Grüber, to *Colpoda*, has been remarked by its discoverer, but the resemblance between the latter and the form here referred to is even more conspicuous than with the type, and would necessarily place it in the genus *Colpoda* were not the pharyngeal series of cilia present. These cilia are apparently larger but much shorter than those of the general cuticular surface, which are long and very fine. They are with difficulty separately resolved unless the infusorian is in a weakened or dying condition; otherwise their motion is incessant.

sant, and they themselves become visible only through their effect. They depend from the entire internal surface of the membraneous pharynx, projecting slightly, if at all, beyond the oral aperture. The cilia of the general surface are extremely fine and, like those in the pharynx, can be satisfactorily distinguished only when the animal is quiescent, those situated anteriorly then showing themselves to be somewhat the largest. The body is grooved obliquely, the striations being especially distinct on the anterior body-half. The circular oral aperture is placed in the centre of the ventral surface and, as the infusorian is swimming at ease, appears to be lateral. It is followed by the short membraneous pharynx curving toward the posterior extremity of the zoöid and bearing the vibratile series already referred to. The endoplasm, usually colorless, encloses several linear, straight, or slightly curved, dark-bordered bodies, and numerous small corpuscles which at times render the body semi-opaque. The nucleus is large and situated near the centre of the dorsal region, commonly opposite, occasionally slightly in advance of the pharynx and oral aperture. The contractile vesicles increase in numbers with the creature's age. In early youth the pulsating vacuole is single and postero-terminal; when the *Tillina* is mature, or nearly so, two, three or even four, posteriorly placed, are not uncommon.

Reproduction is accomplished by encystment followed by spore formation, and by fission into two or more zoöids, the young in the latter event differing in form so conspicuously from the mature animal that, before the life-history had been traced, they were mistaken for another species and described as such in manuscript. The act is performed without immediate conjugation; whether in the instances observed there had been a remote union, I of course do not know.

Individuals have several times been so accommodating as to enter the field of the objective just before the beginning of the first stage in this reproductive act, thus affording me an opportunity to follow the changes with ease. The body is soft and

flexible, but, except immediately prior to encystment, is not changeable in shape. At that time, however, the animal assumes a spherical form, and prepares a cyst so delicate and transparent that ordinarily it is invisible after its evacuation; but occasionally it collapses as a shapeless exuvium containing several bright bubble-like spots, and rarely becomes for a very short time slightly amœboid. Fission is accomplished within this sac, and I have in one or two instances observed a binary division without the formation of an enclosing membrane; but in every case it seems that the divided surfaces become the ventral. The process, at least when four zooids are the result, consumes about two hours from the assumption of the spherical form. The young force their way from the cyst through a small opening visible only in its effect upon the shape of the emerging creatures. A small knob-like projection first appears, and as the animal urges itself through the aperture, a narrow and sharply defined constriction passes successively over the whole length of the body, each of the little animals emerging through the same opening. The young and the old differ, as shown in lateral view in figures 21 and 22, the latter being the mature form, in which the dorsal surface, as seen in profile, is much more strongly and evenly convex, and the ventral more flattened, than in figure 21. In the infusion, forms intermediate in shape and size were abundant. The length of the zooid immediately after emergence is $\frac{1}{1000}$ inch, at maturity, $\frac{1}{750}$ inch.

The species seems to be not very susceptible to the deoxygenation of the water, thriving and multiplying where more sensitive Infusoria would soon die. But when the supply of oxygen becomes too limited for even its small demands, the second form of reproduction, that of sporular subdivision of the entire body, takes place. The zooid assumes a spherical shape as before, but now prepares a distinct and substantial cyst, in which the subdivision is accomplished. I have witnessed the formation of these cysts in very many instances, the completion of the process once only. The cyst wall was then suddenly ruptured and the

motionless and finely divided contents thrown out by the collapsing sac, but to my regret were almost immediately lost amid the surrounding clouds of bacteria.

The movement of the infusorian, when first placed on the slide, is rapid and erratic, with rotation on the longitudinal axis; when quieted it is irregularly forward, or in wide circles, usually with one or the other lateral surface downward, thus placing the oral aperture, as already mentioned, apparently upon the side.

TILLINA INFLATA, Stokes. Pl. IV, fig. 25.

Tillina inflata. Stokes: Am. Nat., Feb., 1884; Ann. and Mag. Nat. Hist., June, 1885.

Body irregularly subreniform, obliquely striate, entirely ciliated, the posterior body-half rounded, inflated, conspicuously widened and somewhat oblique; the anterior half compressed, its ventral surface flattened; oral aperture ovate, ventral, obliquely placed, and followed by a short, recurved, entirely ciliated pharyngeal passage; nucleus ovate or spheroidal, subcentrally located; contractile vesicle single, spherical, postero-terminal; anal aperture postero-terminal, in close proximity to the pulsating vacuole. Length of body $\frac{1}{500}$ to $\frac{1}{600}$ inch. Habitat.—Water in which the bulbs of a Chinese *Narcissus* were growing.

This interesting creature is found only in the habitat mentioned, but always there. Its movements are very similar to those of *T. flavicans*. The food-masses also receive the spherical form; but the rotation of the endoplasm so noticeable in *T. flavicans* is here seldom visible. In color, the infusorian is a deep amber, the tint varying with that of the infusion, and, to a certain extent, with age, the young animalcules being paler than the mature. Reproduction takes place by encystment, with subsequent binary or quadruple fission, the young resembling the undivided forms in all except color. Conjugation has not been observed.

Family TRACHELOCERCIDÆ, S. K.

Genus TRACHELOCERCA, Ehr.

TRACHELOCERCA OLOR, Müll.

Genus LACRYMARIA, Ehr.

LACRYMARIA VERTENS, Stokes. Pl. IV, fig. 18.

Lacrymaria vertens. Stokes: Am. Monthly Micros. Jour., vi, July, 1885.

Body subcylindrical, soft, flexible, and somewhat extensile, about three times as long as broad, longitudinally striate; constricted near the middle, the lateral borders consequently concave; cilia fine and numerous; apical extremity rounded, oral cilia numerous; contractile vesicle single, spherical, postero-terminal; nucleus ovate, conspicuous, located in the anterior body-half; endoplasm usually coarsely granular. Length of body $\frac{1}{300}$ inch. Habitat.—Stagnant pond-water.

This readily recognized form is one of the three fresh-water species hitherto observed. The body is very flexible, insinuating itself with ease among and between tangled threads of fungi and heaps of debris. The anterior extremity seems to be the most extensile portion, the region also retracting itself until the smooth apical hemisphere, which is pierced centrally by the oral aperture, is apparently sunken and surrounded by a deep circumvallation, the characteristic constriction of the body then being lost by the dilation of the part. The movements are by rapid revolutions on the longitudinal axis.

LACRYMARIA TERES, Stokes. Pl. IV, fig. 19.

Lacrymaria teres. Stokes: Am. Monthly Micros. Jour., May, 1886.

Body elongate-clavate, subcylindrical, very soft and flexible, six to seven times as long as broad, narrowest and somewhat attenuate and depressed anteriorly; posterior extremity rounded; anterior border obliquely and convexly truncate; cuticular surface finely striate longitudinally; cilia in the apical groove and on the general cuticular surface not conspicuously differing in size; contractile vesicle consisting of two conspicuous spherical

vacuoles, one postero-terminal, the other situated in the anterior body-half near one lateral border, the two connected by a narrow, tortuous, canal-like channel penetrating the endoplasm, and often laterally developing spherical or irregular lacunæ; oral aperture terminal; endoplasm granular. Length of body $\frac{1}{150}$ to $\frac{1}{125}$ inch. Habitat.—Standing water with decaying vegetation from the cypress swamps of South Florida.

This species differs from *L. truncata* not only in size and more cylindrical contour, but chiefly in the possession of the complex contractile vesicles, and in the absence of the remarkably convoluted nucleus characteristic of that infusorian. The animalcules abounded in the habitat mentioned, but in none, even after the repeated application of reagents and staining fluids, could a nucleus be observed.

The oral aperture is remarkably expansile. Repeatedly the infusorian has been observed to seize *Dexiotricha plagia* so that the latter animalcule was at right angles to the body of the *Lacrymaria*, yet the oral aperture expanded until its width almost equalled the length of the captured zoöid, a length equal to about $\frac{1}{400}$ inch.

LACRYMARIA TRUNCATA, Stokes. Pl. IV, fig. 23.

Lacrymaria truncata. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body flask-shaped or clavate, flattened, very soft and flexible, four and one-half to five times as long as broad, narrowed into a neck-like region anteriorly, the frontal border of which is somewhat dilated and obliquely truncate, the apical groove conspicuous; the posterior extremity rounded; entire surface strongly and longitudinally striate; cuticular cilia long and fine; oral aperture terminal, followed by a long conical, membranous pharynx, visible only after death; apical groove bearing a single row of cilia; contractile vesicle single, spherical, postero-terminal; nucleus long, band-shaped, variously curved and twisted, having several laterally-attached nuclei; anal aperture postero-terminal. Length of body $\frac{1}{200}$ inch. Habitat.—Standing water, with dead leaves.

This is remarkable for the very long and band-like nucleus, and especially for the capacious conical pharyngeal passage, which has hitherto not been recorded as appearing in any of the several marine species. It is here visible only after the animalcule's death, which in this instance was accomplished by the glycerole of tannin, when it becomes conspicuous, and is seen to occupy almost the entire width of the frontal border, thence tapering to an acute termination and extending through about one-third of the entire body.

In most of the marine species the apical extremity is conical; here, however, and in most of the fresh-water forms, it is conspicuously flattened, oblique and truncate. As the infusorian now referred to is undoubtedly a member of the genus *Laerymaria*, a slight change in the generic diagnosis would seem necessary; and such change would be preferable to the erection of a new generic title for the creature, as might seem desirable on account of the cushion-like apical extremity and the extensively developed pharyngeal passage. The latter probably brings the genus closer to the *Lagynus* of Quennerstedt, in which the pharynx is plicate and the apical groove wanting. The movements of the infusorian are rapid, and usually by rotation on the long axis.

Genus LAGYNUS, *Quenn.*

LAGYNUS LASIUS, *Stokes.* Pl. IV, fig. 17.

Lagynus lasius. Stokes: Am. Monthly Micros. Jour., vi, July, 1885.

Body normally flask-shaped, about three times as long as wide, longitudinally furrowed, the ventral surface flattened; contractile to an ovate form, and extensile until elongate-clavate or subcylindrical; anterior extremity rounded, oral aperture terminal; oral cilia conspicuous, those of the general surface long, numerous vibrating somewhat irregularly and independently, and confined chiefly to the body posterior to the anterior neck-like prolongation, the latter being rather sparingly ciliate and bearing numerous immotile, hispid setæ, a series also con-

tinued down the dorsal surface to near the posterior extremity; pharynx conspicuous, longitudinally plicate; nucleus subcentral; contractile vesicle single, postero-terminal. Length of body $\frac{1}{260}$ inch. Habitat.—Fresh water.

A noteworthy feature of this little bottle-shaped creature is that the neck is abundantly clothed with short, stiff bristles with a great decrease in the number of the vibratile cilia, which in equal abundance are borne on the remaining body surface. At first glance the appearance of this roughened neck is such as to lead the observer to at once imagine that the infusorian has recently taken part in a fierce battle, and has had the anterior cilia broken or in some way incompletely removed; but the perfect condition of the oral circle, and the continuation of a row of the setæ down the median line of the dorsum, show that the condition is normal and the infusorian uninjured.

The movements vary with the form. When flask-shaped, progression is evenly forward on the flattened ventral surface; when contracted to the broad egg-shaped, or extended to the subcylindrical form, it rotates on its long diameter.

Family TRACHELIIDÆ, *Ehr.*

Genus TRACHELIUS, *Ehr.*

TRACHELIUS OVUM, *Ehr.*

Trachelius Leidyi. Foulke: Proc. Acad. Nat. Sci. Phila., 1884; Jour. New York Micros. Soc., 1885.

Trachelius ovum. Foulke: Jour. New York Micros. Soc., 1885.

Genus AMPHILEPTUS, *Ehr.*

AMPHILEPTUS GIGAS, *C. & L.*

Phragelliorhynchus nasutus. Herrick: Science, iv, July 18, 1884.

AMPHILEPTUS MARGARITIFER, *Ehr.*

AMPHILEPTUS MONILATUS, *Stokes.* Pl. IV, fig. 32.

Amphileptus monilatus. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body elongate, subfusiform, about fifteen times as long as broad, the dorsal surface flattened, the ventral convex, the

anterior trunk-like portion forming one-fourth of the entire length of the body, the posterior attenuate tail-like part about one-sixth of that length, the trunk bearing a fringe of larger cilia on its lower surface, and an even inferior row of trichocysts; contractile vesicles small, numerous, in a single series along the dorsal border, but not extending into the posterior attenuation; nucleus moniliform, the nodules small, ovate; pharynx conical, finely plicate; anal aperture at the base of the caudal prolongation. Length of body $\frac{1}{35}$ inch. Habitat.—Still water, with *Ceratophyllum* and *Utricularia*.

In general appearance this infusorian closely resembles *A. gigas*, C. & L., differing chiefly in the shorter trunk, and especially in the moniliform nucleus, the latter, in *A. gigas*, being band-like.

In connection with *A. gigas* I have been able to verify the statement of Wrzesniowski, that reproduction takes place by oblique central fission. The first noticeable change in the appearance of the body is the development of an obliquely directed subcentral ridge apparently surrounding the animalcule. The division is rapid, the anterior portion of the posterior moiety being very obliquely truncate and finally developing into the trunk, the posterior surface of the anterior part being evenly rounded immediately after fission. The oral aperture and conical pharynx are formed in the posteriorly separating moiety before the final division of the two individuals. Conjugation has been observed with a form which I have identified doubtfully with *A. margaritifera*, Ehr., union taking place between the parts anterior to the oral aperture, this orifice being occasionally included.

Genus LOXOPHYLLUM, Duj.

LOXOPHYLLUM VORAX, Stokes. Pl. V, fig. 1.

Loxophyllum vorax. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body elongate-lanceolate, three times as long as broad, longitudinally striate, soft, flexible and elastic, both extremities

rounded and somewhat curved towards the ventral border, the posterior widest, the body tapering thence towards the frontal region; oral aperture subterminal, enormously expansile; dorsal border convex, the ventral usually flattened; nucleus single, ovate, subcentral; contractile vesicle single, spherical, situated near the ventral border of the posterior extremity; trichocysts numerous, conspicuous, arranged in a parallel series perpendicular to the frontal, dorsal and posterior borders; anal aperture not observed. Length of extended body $\frac{1}{190}$ inch. Habitat.—Standing water, with *Sphagnum*.

In a single instance the transparent, colorless body was wonderfully distorted by the internal pressure of two rotifers which the infusorian had engulfed. The body was here scarcely longer than broad, and the surface was most irregularly protruded. As digestion was accomplished the normal contour was resumed, and the animal's sluggish movements became more active. When swimming the movements are often rotatory on the long axis.

LOXOPHYLLUM FLEXILIS, Stokes. Pl. IV, fig. 26.

Loxophyllum flexilis. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body irregularly ovate, lanceolate, or subtriangular, three times as long as broad, lamellate, transparent, very soft and flexible, widest posteriorly, tapering toward the anterior extremity, which is somewhat curved toward the ventral aspect; the posterior margin obliquely and undulately rounded, the ventral border concave, the dorsal one irregularly convex, its posterior region bearing two small, conical elevations; the cuticular surface furrowed lengthwise, often thrown into longitudinal folds, entirely ciliated, the cilia of the anterior extremity somewhat longest and most conspicuous; oral aperture opening subterminally on the ventral surface; contractile vesicles three or more, the largest one postero-terminal, the others small and scattered; nucleus moniliform, the nodules irregularly ovate, centrally situated; trichocysts apparently wanting. Length of

body $\frac{1}{200}$ inch. Habitat.—The bacterial pellicle on the surface of an infusion of dead leaves.

The movements of the infusorian are slow and even, with uncertain changes from one side to the other, and with equally unexpected contortions consisting of indescribable twistings and foldings of the body. The creature's remarkably irregular outline is made more so by the two little papilliform projections on the posterior part of the dorso-lateral border. These are constantly present, but vary somewhat in size and form. What utilitarian purpose they may subserve it is difficult to conjecture.

In a single instance I have observed what appeared to be the conjugation of two of these animalcules. The combination resulting from this union was almost indescribably irregular, being thrown into numerous folds and plications and rounded projections, the entire creature exhibiting the most deliberate and grotesque writhings and twistings. The separate animalcules were not seen previously to this apparent union, and so long as it was convenient to follow the apparent combination, no change except change of form took place.

Family OPHRYOGLENIDÆ, S. K.

Genus OPHRYOGLENA, Ehr.

OPHRYOGLENA OVATA, Stokes. Pl. IV, fig. 29.

Ophryoglena ovata. Stokes: Am. Monthly Micros. Jour., vi, Oct., 1885.

Body ovate, soft, flexible and somewhat changeable in form, about once and one-half as long as broad; ventral surface somewhat flattened; both extremities usually evenly rounded, the posterior one occasionally slightly and obtusely pointed, the frontal one commonly the broader; cuticular surface delicately striate longitudinally, the cilia fine and short; oral aperture ovate, ciliated, obliquely placed at a short distance from the frontal border, followed by a somewhat curved, apparently ciliated pharynx, posteriorly enclosing a vibratile membrane; contractile vesicle double, spherical, situated in the anterior and posterior body-halves, frequently stellate at diastole, and having long filiform

diverticula; endoplasm colorless, crowded with irregular, colorless and variously tinted corpuscles; nucleus not observed. Length of body $\frac{1}{100}$ inch. Habitat.—Still water, with *Ceratophyllum* and *Utricularia*. Movements rotary.

Of the unequal corpuscles crowding the body, the smaller, more nearly colorless ones are probably amylaceous in character, the large, variously tinted plates presumably being partially digested food-masses. The nucleus was not determined. It remained invisible even after the application to the body of reagents and staining fluids.

Genus DALLASIA, Stokes.

Animalcules free-swimming, elongate-ovate, subcylindrical, produced posteriorly in a more or less retractile tail-like prolongation; oral aperture ventral, enclosing two vibratile membranes; contractile vesicle single; trichocysts absent.

The proper position of the genus is probably with the Ophryoglenidæ of Kent, although the presence of two vibratile membranes will necessitate a slight change in the diagnosis of the family as now formulated.

DALLASIA FRONTATA, Stokes. Pl. IV, figs. 30 and 31.

Diplomastax frontata. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Diplomestoma frontata. Stokes: Ann. and Mag. Nat. Hist., April, 1886.

Dallasia frontata. Stokes: Ann. and Mag. Nat. Hist., June, 1886.

Body elongate-obovate, subcylindrical, transparent, longitudinally striate, and finely reticulated, five times as long as broad, the lower or ventral surface convex, the dorsal slightly concave, tapering posteriorly to a somewhat retractile tail-like prolongation forming about one-fifth of the entire body; anterior extremity narrowed, obtusely pointed; oral aperture narrow, ovate, obliquely placed on the ventral or convex surface at some distance from the anterior extremity, enclosing two small vibratile membranes; contractile vesicle single, spherical, near the centre of the dorsal or concave border; nucleus presumably repre-

sented by a large, ovate, subcentral, clear space. Length of body $\frac{1}{180}$ inch. Habitat.—Still water, with *Myriophyllum*.

The aspect of this interesting infusorian floating on the concave or dorsal surface, with the obliquely placed oral aperture thus directed upwards, at once suggests the thought of a microscopic shark, the suggestion and the resemblance not being far-fetched. It is only the appearance, however, that brings the shark to mind.

Reproduction is accomplished by transverse fission, presumably after conjugation, which I have observed, union being made at the anterior portions of the ventral surfaces. When fission is about to take place that part of the body in advance of the oral aperture elongates, an opening, which finally becomes the mouth of the anterior moiety, forming at or near the frontal border, and developing from each side a very conspicuous vibratile membrane, the one on the right-hand margin usually being the larger. The frontal cilia are then also more conspicuous and apparently larger than in the mature individual. The dividing portion finally separates, having the posterior tail-like prolongation and a terminal oral aperture containing the two prominent membranes, leaving the posterior or original animalcule apparently unchanged. The separated moiety, which at first but remotely resembles the mature animalcule, remains sluggish for some time. The large, projecting, flap-like membranes on the frontal border seem to be an incumbrance, and, until the oral aperture assumes its proper position and the membranes become enclosed, the infusorian seldom moves unless jostled by some more active inhabitant of the life-slide, when it quickly darts forward only to assume its quiet waiting. The existence of the two vibratile flaps might readily have been overlooked, or the two mistaken for a single one, if reproductive fission had not been observed, since to separate them, even with a high-power objective, is no easy matter.

Genus HYMENOSTOMA, Stokes.

Animalcules free-swimming, ovate, persistent in form, more or less depressed, entirely ciliate, a fascicle of several diverse, flexible, setose cilia projecting posteriorly; adoral groove large, ventrally disposed, somewhat on the right-hand side of the median line, bearing on its left-hand margin a row of vibratile cilia, and on its right-hand and frontal borders a vibratile membrane; oral aperture ovate, situated at the posterior and deepest part of the adoral depression, and bearing an extensile and retractile membrane on its anterior and left-hand margins; contractile vesicle double; nucleus posteriorly located; anal aperture postero-terminal.

HYMENOSTOMA HYMENOPHORA, Stokes. Pl. V, fig. 2.

Hymenostoma hymenophora. Stokes: Am. Monthly Micros. Jour., v, July, 1884.

Body ovate, depressed, the length about twice the width, striate, longitudinally; dorsal surface convex, the ventral flattened, somewhat concave; the posterior extremity rounded, the anterior slightly emarginate; the left-hand border convex, the right-hand margin somewhat flattened; cilia of the cuticular surface fine and short, those on the posterior extremity more conspicuous; the posteriorly projecting setose fascicle formed of hair-like, flexible cilia of diverse length, two being usually of equal length and distally curved, the whole commonly directed obliquely toward the left; adoral depression large, obovate, longitudinally disposed, widest anteriorly and extending backwards and inwards for a distance equalling about six-sevenths of the entire length of the body; oral aperture large, ovate, placed on the right-hand side of the median line of the adoral depression, the extensile and retractile membrane which partly surrounds it thrown into folds on its left-hand margin; adoral cilia fine, dense, extending across the adoral depression and ordinarily visible only after the infusorian's death; the membrane attached to the right-hand border of the adoral groove volun-

tarily vibratile, projecting from the anterior extremity as a short, conical, hood-like extension, one side of this projection inserted on the anterior left-hand margin of the adoral depression, the other side continued as a conspicuous, lamellate membrane for about one-half the length of the adoral groove, when it is abruptly narrowed and thence descends into the depression, is continued to its posterior extremity and is apparently continuous with that surrounding the oral aperture; nucleus elongate, band-like, curved, posteriorly located near the right-hand border; contractile vesicle double, diverse in size, one very small and situated near the dorsal surface and subcentral to the right-hand margin, pulsating quickly and almost immediately re-appearing through the coalescence of several minute vacuoles, the other large, posteriorly placed somewhat to the left-hand side of the median line, pulsating at long intervals and forming slowly; parenchyma transparent, minutely granulate. Length of body $\frac{1}{500}$ inch. Habitat.—The surface of decaying leaves at the bottom of shallow pools.

This infusorian resembles *Lembadion*, and will probably follow it in a scheme of classification. The movements of both are also similar. When first placed on the microscope slide they swim backwards by rapid revolutions on their long axes, the motion probably being caused by the vibrations of the adoral membrane. When quietly searching for food they swim evenly forward or in irregular circles. *Hymenostoma* differs from *Lembadion* in the posterior, ventral position of the mouth, the greater length of the adoral cilia, the abruptly narrowing membrane, the double contractile vesicle, and the greater number and sinistrally directed setæ of the posterior extremity, four being the usual complement with this species of *Hymenostoma*.

In its food-habits *Hymenostoma* is omnivorous, taking diatoms and animalcules of comparatively enormous size, often leaping from side to side as if eager to seize its prey. The food particle is often somewhat larger than the oral aperture, so that the entrance becomes blocked and the captive not at once engulfed.

Just how this engulfing process is performed I have not learned. Neither the adoral cilia nor the oral membrane seem to take active parts. The cilia on the left-hand margin of this depression are seen to be very fine and dense when the animalcule has been killed, having, after death by iodine, the property of falling from their attachment as a continuous fringe. At other times they are rarely visible, on account of their rapid vibrations. The mouth is also often very inconspicuous until the surrounding membrane is extended and vibrated. The food, after passing this opening, invariably takes a position in the left side of the body.

The rate of pulsation of the smaller contractile vesicle is not constant.

HYMENOSTOMA MAGNA, *Stokes*. Pl. V, fig. 3.

Hymenostoma magna. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body ovate, depressed, about twice as long as broad, the dorsal surface convex, the ventral flattened and chiefly occupied by the wide adoral depression or groove which extends from the frontal border almost to the posterior extremity, the latter slightly produced and truncate, a broad tuft of larger cilia fringing the truncation; anterior border narrowly and obliquely rounded; left-hand margin of the peristome bearing a row of long, fine cilia, directed across the depression; the left-hand border furnished with an undulating membrane, widest anteriorly and projecting beyond the anterior margin of the body as a sinistrally directed, concave, acumination; oral aperture near the posterior extremity of the peristome field; nucleus ovate, slightly curved, posteriorly located on the right-hand side of the body; contractile vesicle double, one large, near the posterior extremity, the other smaller, near the right-hand side of the body-centre, and formed, after systole, by the coalescence of several small vacuoles; cuticular surface finely striate longitudinally. Length of body $\frac{1}{2\frac{1}{5}}$ inch. Habitat.—Standing pond-water. Movements by rapid revolutions on the longitudinal axis, and often backward.

This, only the second member of the genus thus far discovered, is readily distinguishable from *Hymenostoma hymenophora* by the larger body, it being about twice the size of that of the last-mentioned species, by the posterior truncation with its fringe of longer cilia, and by the form of the peristomal membrane with its anteriorly projecting acumination. As in the former species the food-masses in this member of the genus collect in the left-hand side of the body.

Conjugation has been observed, union taking place between the ventral surfaces of the right-hand body-margins.

Genus COLPIDIUM, Stein.

COLPIDIUM CUCULLUS, Schrank.

COLPIDIUM PUTRINUM, Stokes. Pl. V, fig. 4.

Colpidium putrinum. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body ovate, less than twice as long as broad, longitudinally striate, the anterior extremity obtusely pointed, the ventral surface slightly flattened; vibratile membrane small; contractile vesicle single, spherical, laterally located near the posterior extremity; nucleus subspherical, subcentrally placed; endoplasm granular, usually crowded with small spherical food-masses; anal aperture inferiorly postero-terminal. Length of body $\frac{1}{450}$ to $\frac{1}{650}$ inch. Habitat.—A putrid vegetable infusion in creek-water.

Reproduction is by transverse fission, a second contractile vesicle generally appearing previous to the beginning of the process.

COLPIDIUM TRUNCATUM, Stokes. Pl. IV, fig. 27.

Colpidium truncatum. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body somewhat reniform, from two to three times as long as wide, striate longitudinally, compressed anteriorly, the extremities subequal in width, the posterior one evenly rounded, the anterior somewhat curved toward the ventral aspect, the frontal border obliquely truncate; oral aperture ovate, the pharynx

long; vibratile membrane large, conspicuous; contractile vesicle single, located on the right-hand border of the posterior extremity near the dorsal surface; nucleus ovate or subspherical, single, subcentral; anal aperture postero-terminal. Length of body $\frac{1}{500}$ to $\frac{1}{600}$ inch. Habitat.—Standing water, with *Myriophyllum* and other aquatic plants.

This form was for a time very abundant in a small vessel of water from an aquarium containing *Myriophyllum* in various stages of growth and decay. It differs from the hitherto known members of the genus in the oblique truncation of the frontal border, and the position of the contractile vesicle. In numerous instances conjugation was observed, union taking place between the anterior third of the ventral surface of each animalcule. Transverse fission was also repeatedly noticed, the newly-separated animalcules being subspherical in form, soon, however, assuming the normal contour of the adult infusorian.

COLPIDIUM STRIATUM, Stokes. Pl. IV, fig. 28.

Colpidium striatum. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body subreniform, twice as long as broad, longitudinally striate, the anterior extremity slightly curved towards the ventral aspect; vibratile membrane conspicuous; contractile vesicle single, spherical, postero-lateral, often leaving several small vacuoles after systole; nucleus single, subcentral. Length of body $\frac{1}{500}$ inch. Habitat.—An infusion of decaying aquatic vegetation.

In form this resembles *C. cucullus*, Schrank, being somewhat more curved anteriorly. It differs in having but one nucleus, and in the postero-lateral position of the pulsating vacuole. Reproduction is by transverse fission.

Genus HISTIOBALANTIUM, Stokes.

Animalcules free-swimming, ovate, somewhat depressed, persistent in shape, the ventral aspect flattened; setose hairs abundantly developed on all parts of the surface; the oral fossa

near the centre of the ventral aspect, on the left-hand side of the median line, ovate, capacious, the cilia of the left-hand border long, fine, setose, the frontal wall bearing a ciliary tuft, and the right-hand margin supporting an undulating membrane, which forms posteriorly a freely motile infundibuliform sack continued backward as a narrow membraneous tubular passage, at the posterior extremity of which is the oral aperture, the oral fossa also enclosing anteriorly a secondary vibratile tuft of long cilia; contractile vesicle multiple; nucleus ovate, anteriorly situated. Habitat.—Fresh waters.

HISTIOBALANTHUM AGILE, *Stokes*. Pl. V, figs. 5 and 7.

Histiobalanthum agile. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body ovate, one and a half times as long as broad, somewhat depressed, the dorsal surface convex, the ventral slightly flattened, both extremities evenly rounded; the left-hand body-margin evenly convex, the right-hand border gibbous; cuticular cilia abundant, curved; numerous long, fine, setose hairs projecting from all parts of the surface; oral fossa ovate, capacious, situated near the centre of the right-hand side of the ventral aspect, its posterior region supporting a conspicuous retractile and freely motile, infundibuliform, membraneous sack, which is posteriorly prolonged as a narrow, flexible, membraneous and tubular passage leading to the oral aperture, and anteriorly continued as a broad undulating membrane attached to the right-hand border of the oral fossa, and as an inconspicuous membraneous velum adherent to the left-hand side of the same depression and enclosed within it; adoral cilia on the left-hand margin of the oral depression long, fine, setose; a broad tuft of long setose cilia springing from the frontal border of the oral fossa, and directed backward, a second broad tuft of vibratile setose cilia anteriorly enclosed within the oral cavity, attached to the anterior superior wall, their posterior extremities free; oral aperture near the posterior extremity of the body, followed by a short, somewhat adcurved pharyngeal passage; contractile ves-

icles small, multiple, scattered; nucleus ovate, situated near the anterior border; anal aperture not observed; endoplasm granular, colorless, transparent. Length of body $\frac{1}{375}$ inch. Habitat.—Fresh water, with *Ceratophyllum*.

The enclosed adoral sack and its posterior tubular prolongation appear to be adherent to the walls of the oral fossa only at the point where the tubular passage surrounds the oral aperture, and anteriorly by the membraneous continuation of the infundibulum. The entire organ, composed of bag-like velum and tubular adoral passage, is freely motile, being variously protruded and retracted and rolled from side to side, the thin anterior right-hand membrane being at times thrust into the oral fossa or arched above it like a protecting shield. The enclosed superior vibratile tuft of cilia, which, so far as I have observed, never protrudes beyond the margin of the oral fossa, is, when not in motion, usually pressed upward against the roof of the cavity, and when the infusorian is viewed in a lateral position, or in vertical optic section, appears like a thickened edge of a vibratile membrane; it is only when the animalcule is examined by focusing through the thickness of the body from the dorsal surface, or when the creature fortunately comes to rest with the ventral aspect towards the observer, that the true character of the organ can be ascertained. The cluster widens posteriorly by a separation of its constituent cilia, as also does the lower and more nearly external frontal tuft. The latter, however, seldom or never vibrates. Its function appears to be to assist in imprisoning the food by closing down over the cavity, or by entering the latter in company with the undulating membrane.

The setose hairs extending beyond the cuticular cilia are about twice their length. They are evidently tactile in function, being used to inform the infusorian of the approach of food, or of an enemy to be avoided. If the former, the animalcule immediately and most actively leaps upon it, seizing and forcing it into the endoplasm so quickly that, although I have repeatedly wit-

nessed the act, I am ignorant of the precise method employed in the capture. If an approaching free-swimming animalcule ever so lightly touches a setose hair on any part of the surface, *Histiobalantium* at once leaps upon it, frequently making a half-revolution on the transverse axis, and seldom missing the object wished for. The undulating membrane closes over the oral depression, often forcing itself within the cavity, the infusorian makes a strong contractile, somewhat convulsive effort, at once reminding the observer of the similar movement by *Floscularia ornata* when food is passing onward towards the mastax, and the captive is dashed through the oral aperture into the posterior part of the body, whence it is gradually transferred to the anterior and dorsal regions for digestion. The whole act is performed with remarkable swiftness, the food being accompanied by an unusually large bubble of water, as if the oral fossa had poured its entire liquid contents into the endoplasm. This habit probably accounts for the development of the multiple contractile vesicles. The peculiar springing movements described are, it is supposed, caused by the sudden action of the setose hairs so abundant on the body.

The entire oral apparatus is remarkably complex. I may therefore have misinterpreted some of the appearances.

Family CALYPTOTRICHIDÆ, *Stokes*.

Animalcules free-swimming or loricate, entirely ciliate, more or less ovate in form; oral aperture ventral, supplemented by a vibratile as well as retractile and extensile membraneous, hood-shaped velum.

The hood-like velum resembles in character and function the oral appendage of the members of the Pleuronemidæ, widely differing, however, in its vibratile power, the Infusoria forming the group of the Pleuronemidæ, having the ability to raise and lower the organ without the additional power of rapid vibration possessed by the Calyptotrichidæ. The hood-like appendage is,

in both groups, folded and stowed away about the posterior and lateral margins of the oral aperture.

The family is erected on the *Calypotricha pleuronematoides* of Mr. F. W. Phillips (*Jour. Royal Micros. Soc.*, II, p. 799).

Genus SAPROPHILUS, Stokes.

Animalcules free-swimming, ovate, soft, flexible and changeable in shape; general cuticular surface clothed with fine vibratile cilia, a single, long, flexible seta projecting from the posterior extremity; oral aperture ventral, supplemented by a vibratile and retractile hood-like velum.

SAPROPHILUS AGITATUS, Stokes. Pl. IV, fig. 24.

Saprophilus agitatus. Stokes: *Proc. Am. Philos. Soc.*, xxiv, 126, 1887.

Body ovate, compressed, about twice as long as broad, the posterior extremity rounded, the antero-ventral border obliquely truncate; cuticular surface longitudinally striate, the cilia short and fine; oral aperture ovate, on the ventral surface at a short distance from the anterior extremity, the hood-shaped appendage short, widest posteriorly, narrowing to its anterior termination, rapidly vibratile; contractile vesicle single, spherical, located in the posterior body-half; nucleus subspherical, subcentrally placed. Length of body $\frac{1}{750}$ to $\frac{1}{560}$ inch. Habitat.—An infusion containing much decaying animal matter. Reproduction by transverse fission.

The animalcules are extremely soft and quite changeable in shape, the change, however, usually consisting chiefly in the assumption of a subspherical form. They have the power to force themselves through small openings, the body-sarcode then flowing almost as freely as if it were semifluid. These infusoria are essentially scavengers, greedily appropriating decaying animal fragments, swarming in crowds around and within the dead bodies of various small aquatic animals. Within the body of a dead *Gammarus* sp. they have been observed in profusion,

and there rapidly undergoing reproductive fission, the process probably being hastened by the abundance of stimulating food.

Genus CALYPTOTRICHA, *Phillips*.

CALYPTOTRICHA INHÆSA, (*Kellicott*) *Stokes*. Pl. V, figs. 8 and 9.

Diplospylla inhæsa. Kellicott: Proc. Am. Soc. Micros., 1885.

Body ovate, somewhat pointed anteriorly, less than twice as long as broad; cilia of the general cuticular surface fine and long; oral aperture situated on the posterior body-half of the ventral surface, the undulating, hood-shaped membrane, inserted in a circum-oral groove or depression, and when seen in profile, fully extended, apparently subsemicircular; adoral cilia setose; a few setose apparently non-vibratile cilia projecting from the posterior extremity; nucleus ovoid, situated in advance of the oral aperture; contractile vesicle near the posterior margin, small, and pulsating slowly; endoplasm transparent. Lorica elongate-ovate, hyaline, the extremities tapering, the terminal apertures about one-half as wide as the centre of the sheath, truncate, the margins not everted. Length of lorica $\frac{1}{140}$ to $\frac{1}{120}$ inch; of the enclosed animalcule $\frac{1}{800}$ inch. Habitat.—Fresh swamp-water; attached laterally to filamentous algæ. Reproduction by transverse fission. (Point Abino, Ontario. *Kellicott*).

Prof. Kellicott reports that the infusorian is almost ceaselessly in motion, turning over and over, and quickly reversing its position within the lorica, never, except after reproductive fission, deserting the sheath, when only the resultant zoöid becomes temporarily free-swimming. Food particles are gathered from the currents flowing through the lorica under the influence of the vibrations of the cilia and the oral membraneous hood.

Family PLEURONEMIDÆ, *S. K.*

Genus PLEURONEMA, *Ehr.*

PLEURONEMA CHRYSALIS (*Ehr.*) *S. K.*

*Genus CYCLIDIUM, Ehr.**CYCLIDIUM GLAUCOMA, Ehr.**CYCLIDIUM LITOMESUM, Stokes. Pl. V, fig. 10.*

Cyclidium litomesum. Stokes: Am. Monthly Micros. Jour., v, Dec., 1884.

Body ovate, somewhat compressed, longitudinally striate, the length about two and one-half times the width, the extremities subequally rounded; dorsal surface convex, with a slight sub-central concavity, the ventral one flattened, somewhat concave; oral aperture situated slightly behind the centre of the ventral surface; the lateral and dorsal cuticular surfaces of the central region of the body entirely naked; setæ of the anterior region fine, numerous, their length equalling or exceeding the width of the body, the setæ posteriorly situated diverse in length, several of them exceeding the length of the entire zoöid; contractile vesicle postero-terminal; oral velum or hood large, its width equalling that of the body. Length of the body $\frac{1}{600}$ inch. Habitat.—Pond-water, with *Ceratophyllum*.

This form is distinguished from all other members of the genus by the extreme length of the posterior setæ, and by the unclothed central region of the zoöid. The anterior setæ have the rigid aspect of those of *Pleuronema*, rather than the usual appearance of those of the other members of this generic group.

*Genus URONEMA, Duj.**URONEMA MARINA, Duj.*

A form closely corresponding to this marine species is not uncommon in the writer's locality. It is evidently the fresh-water representative of the salt-water infusorian. In all other characteristics they are essentially the same.

Family TRICHONYMPHIDÆ, S. K.

Genus TRICHONYMPHA, Leidy.

TRICHONYMPHA AGILIS, Leidy.

Trichonympha agilis. Leidy: Proc. Acad. Nat. Sci. Phila., 1881.

Genus PYRSONEMA, Leidy.

PYRSONEMA VERTENS, Leidy.

Pyrsonema vertens. Leidy: Proc. Acad. Nat. Sci. Phila., 1881.

Genus DINENYMPHA, Leidy.

DINENYMPHA GRACILIS, Leidy.

Dinenympha gracilis. Leidy: Proc. Acad. Nat. Sci. Phila., 1881.

Family OPALINIDÆ, Stein.

OPALINA RANARUM, Purk.

OPALINA FLAVA, Stokes. Pl. II, fig. 34.

Opalina flava. Stokes: Am. Natural., Nov., 1884.

Body ovate, inflated, often as long as broad; or subpyriform, widest and rounded posteriorly, the length once and one-half to twice the breadth; the right and left-hand borders evenly rounded; striations of the cuticular surface obliquely disposed and bearing the long, fine, vibratile cilia; nuclei (?) numerous, small, scattered; sarcode enclosing many refractile corpuscles and larger spherical bodies apparently vacuolar; contractile vesicle none; parenchyma lemon-yellow, the color darkest near the periphery, where it is disposed in a layer, the central portion of the sarcode being comparatively colorless. Length $\frac{1}{350}$ to $\frac{1}{350}$ inch. Habitat.—The rectum of the spade-foot hermit toad. *Scaphiopus Holbrookii*.

While making a microscopical examination of the intestinal and stomach contents of young spade-foot hermit toads (*Scaphiopus Holbrookii*), I observed two forms of endoparasitic infusoria so crowding the rectum that it seemed only a thin-walled tube surrounding a semi-solid, writhing mass, which, viewed with a low-power objective, brought to mind the idea of a

shimmering cloud of heated air, or a wavering flame of colorless fire, through which, here and there, glistened a yellow spark.

The rectum of toads and frogs has long been a kind of happy hunting-ground for endoparasites, especially for the *Opaline*; but, so far as I am aware, only colorless species of the genus have been observed. In this instance, however, the yellow points within that living mass proved to be *Opaline* of a lemon-yellow tint. The periphery and, to a much less extent, the deeper portion of the endoplasm are tinged, the color, which appears to be a stain and not an aggregation of particles, being collected in a layer near the cuticular surface, with a quite sharply-defined line of demarcation between the lower margin and the internal body-sarcode.

Genus ANOPLOPHRYA, Stein.

ANOPLOPHRYA CLAVATA, (Leidy) S. K.

ANOPLOPHRYA COCHLEARIFORMIS, (Leidy) S. K.

Discovered by Dr. Leidy, and observed by him alone, in the intestinal canal of *Lumbriculus tenuis*.

ANOPLOPHRYA SOCIALIS, (Leidy) S. K.

Observed by the discoverer and by Miss S. G. Foulke (*Am. Jour. Sci.* 3, xxx, 1885), within the intestinal canal of *Urnatella gracilis*, Leidy.

ANOPLOPHRYA VERMICULARIS, (Leidy) S. K.

Found by Dr. Leidy within the intestinal canal of *Paludina*.

ANOPLOPHRYA NOTEI, Foulke.

Anoplophrya Notei. Foulke: *Am. Jour. Sci.*, 3, xxx, 1885.

Body globose or ovate, variably clothed with cilia more than equalling it in length; nucleus not observed; contractile vesicle

small; endoplasm colorless, hyaline. Length of body $\frac{1}{600}$ inch. Habitat.—Endoparasitic within the body cavity or stomach (?) of *Noteus* sp. (*Foulke*).

ANOPLOPHRYA FUNICULUS, *Leidy*.

Seen by its discoverer alone.

ANOPLOPHRYA MODESTA, *Leidy*.

Observed by Prof. Joseph Leidy alone.

ANOPLOPHRYA MELO, *Leidy*.

Observed only by Dr. Leidy.

ORDER HETEROTRICHA, *Stein*.

Family BURSARIIDÆ, *Stein*.

Genus BURSARIA, *Müll*.

BURSARIA TRUNCATELLA, *Müll*.

Genus NYCTOTHERUS, *Leidy*.

NYCTOTHERUS OVALIS, *Leidy*.

Discovered by Dr. Leidy in the intestinal canal of certain insects.

NYCTOTHERUS VELOX, *Leidy*.

Observed by its discoverer within the intestinal canal of *Julus marginalis*.

Genus METOPUS, *C. & L*.

METOPUS SIGMOIDES, *Müll*.

Genus METOPIDES, *Quenn*.

METOPIDES STRIATA, (*McMurrich*) *Stokes*. Pl. V, fig. 11.

Metopus striatus. *McMurrich*: *Am. Nat.*, xviii, Aug., 1884.

Body obovate or subpyriform, less than twice as long as broad, the posterior body-half tapering, the posterior extremity nar-

rowed and produced as a short, obtuse tail-like prolongation, the anterior body-half apparently folded across the ventral surface toward the left-hand side and nearly at right angles to the longitudinal axis, the left-hand region rounded, projecting beyond the body-margin, the frontal border convex; lateral borders of the cuticular surface conspicuously striate perpendicularly to the body-margins; peristome field widest anteriorly, prolonged to beyond the body-centre; a tuft of long setæ projecting from the posterior tail-like prolongation; nucleus sub-central, spherical, enclosing a nucleolus; contractile vesicle single and near the posterior extremity, or double, one vacuole being located in the anterior body-half; endoplasm anteriorly enclosing numerous strongly refractive granules; anal aperture not observed. Length of body $\frac{1}{300}$ inch. Habitat.—Standing water; Guelph, Canada.

METOPIDES ACUMINATA, Stokes. Pl. V, fig. 12.

Metopides acuminatus. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Body obovate, about twice as long as broad, compressed, the frontal border rounded, the posterior extremity tapering from the body-centre and terminating in a conspicuous acuminate prolongation; the anterior body-half apparently folded obliquely across the ventral surface, the peristomal margin strongly ciliate and prolonged beyond the centre of the body to near the right-hand border; a tuft of long, fine setæ projecting from the posterior acumination; nucleus broadly ovate or subspherical, placed near the body-centre; contractile vesicle single, near the posterior extremity. Length of body, $\frac{1}{375}$ inch. Habitat.—Standing pond-water, with decaying vegetation. Movements rotary on the longitudinal axis.

Genus CTEDOCTEMA, Stokes.

Animalcules free-swimming, more or less ovate, persistent in shape, entirely ciliate; oral cilia diverse to those of the cuticular

surface; oral aperture ventral, located at the posterior termination of a longitudinal, ciliated, adoral depression or groove which bears on its right-hand border a row of large, arcutely curved setose cilia, gradually diminishing in length toward the oral aperture, their distal extremities conspicuously thickened; a single, long, setose hair projecting from the posterior extremity of the body, the distal end curved; contractile vesicle single, posteriorly placed; trichocysts large and numerous.

CTEDOCTEMA ACANTHOCRYPTA, Stokes. Pl. V, figs. 13-16.

Ctedoctema acanthocrypta. Stokes: Am. Nat., xviii, July, 1884.

Body elongate-ovate, widest and rounded posteriorly, tapering to an obtuse anterior apex, subcylindrical, slightly compressed, the length twice to two and one-half times the breadth, a hemispherical sarcode bubble usually present on the left-hand dorso-lateral border; cuticular cilia long, fine, setose, a single postero-terminal seta usually distally curved; oral aperture ciliated, remote from the anterior apex, placed at the posterior termination of a shallow, narrowly ovate, ciliated, adoral groove centrally and longitudinally traversing three-fourths of the ventral surface, and bearing on its right-hand margin a flexible comb-like appendage composed of large, coarse, non-vibratile cilia, thickened distally and diminishing in length as they approach the oral aperture, which they surround; the adoral groove also bearing near its left-hand margin a row of long, fine, vibratile hairs, and throughout its entire length a series of long, vibratile cilia, somewhat fascicled anteriorly and shortening as they approach the mouth; contractile vesicle single, subterminally located near the right-hand border; nucleus ovate, mesially placed in the anterior body half; trichocysts large, straight, apparently prismatic, tapering to an obtuse point, and after extension, bearing distally two or more minute, radiating, linear processes. Habitat.—Fresh-water, with *Lemna*. Length of body $\frac{1}{1000}$ inch.

In its movements the creature is wonderfully swift, darting across the field so quickly that the looker-on can only see that something has passed by. Even when a pleasant feeding-ground is discovered under the lee of an algous filament or a patch of dirt, the lively animal cannot rest, but at frequent and almost regular intervals darts forward for one-half its length and as quickly slips back to its former position. In this rythmic swing it seems to use the tips of the supporting cilia as fulera, thus converting itself into an animated lever of the third class.

The infusorian has the inexplicable habit of protruding subterminally on the left dorso-lateral margin, a colorless, semi-transparent hemisphere of the body sarcode, in which there is often a circulation of the minutely granular protoplasm. The object of this bubble-like protrusion I have been unable to determine. It was at first mistaken for the beginning of a temporary anal aperture, but such use of it has not been observed. It is frequently withdrawn, leaving a lighter smooth spot in its place.

But it is on the ventral surface that we find most of the creature's peculiarities. Originating at the anterior margin and extending almost centrally across the ventral surface, but somewhat obliquely backward and inward, for a distance equal to three-fourths of the animal's entire length, is a shallow, narrowly ovate groove, at whose posterior and widest and deepest part the oral aperture is placed. This depression, narrowest at its anterior origin and gradually and regularly widening to its rounded posterior termination, is clothed with long, fine cilia for about two-thirds of its length. The longest of these vibratile hairs are in length nearly equal to the animal's transverse diameter, being longest and somewhat fasciculately clustered on the extreme anterior margin, thence becoming gradually shorter until about two-thirds of the groove are supplied. They seem to be absent from the remainder of the depression with the exception of the space immediately around the oral aperture, where they are visible only in their effect and in the peculiar glimmer-

ing appearance which they produce, that shimmering of the surface like the wavering of heated air.

Attached to the right-hand margin of the adoral sinus is a series of cilia much coarser and stouter than those on the general surface. Placed in a single row and slightly curving over the adoral depression, they begin anteriorly at a distance from the frontal margin equal to about one-third of the entire length of the groove, the first and foremost cilium being scarcely shorter than the animal's transverse diameter, the length of each succeeding one becoming a little less than the preceding, until the last just rises above the surface immediately behind and somewhat to the left-hand side of the oral aperture. Each member of this comb-like appendage not only curves in accordance with the regular curvature of the series, but has a distinct thickening of its distal extremity, whereby that free end is brought into apparent contact with its neighbor. Under insufficient magnifying power this state of affairs presents the aspect of a long, curved posteriorly originating flagellum, or the lowermost outline of an adoral hood; and when thus examined, the animal presents a striking resemblance to *Pleuronema* or *Cyclidium*. Indeed, we have only to imagine the former as having divided its hood-like velum longitudinally and split up each moiety into transverse filaments, when the resultant creature would bear a strong likeness to *Ctedoctema*. While the animalcule is feeding, these are not actively vibratile, although the whole row has the power of bending in a body across the groove. I have seen them waving back and forth in an unbroken line like an animated comb; and each member of the group also has the ability to separately bend in a direction away from the median line, and it uses this accomplishment when a food-particle, too large or otherwise unacceptable, must be discarded, several often flirting themselves in unison outwardly when there is too great an accumulation about the oral aperture. When their possessor is swimming they are drawn up against the ventral surface parallel with the margin of the

adoral groove, and consequently in contact with each other, their free ends thus pointing posteriorly.

The trichocysts are numerous, large in proportion to the size of the animalcule, and possessed of peculiarities not hitherto noticed in connection with those of any other member of the class. The action of the recently-recommended solution of tannic acid in glycerin for the purpose of rendering trichocysts conspicuous, is eminently successful and satisfactory. When killed by this mixture *Ctedoctema* becomes a nondescript object, woolly with distorted cilia, and having trichocysts projecting from various parts of the surface, they are occasionally so violently extruded that they leave the body and fall away free. The infusorian is $\frac{1}{1000}$ inch in length; the trichocysts are $\frac{1}{2000}$ inch long, precisely one-half *Ctedoctema's* greatest length, and but a fraction shorter than its transverse diameter. Under suitable amplification they are visible within the living animal. Those of the posterior extremity are arranged nearly parallel with the median line; those of the posterior body-half are directed forward, those of the anterior half backward, toward the centre of the creature. They are rigid and straight, and, for their length, coarse and stout. They project slightly beyond the cuticular surface and often give the infusorian, in optical section, a minutely crenated outline.

From their distal end they taper evenly to an obtuse point, and seem to be prismatic. The structural parts which I think have hitherto not been noticed with those of any other infusorian, consist of four, occasionally of only two linear processes radiating from the body of the trichocyst, like the finger-boards on the sign-posts at country cross-roads, as shown in figure 16. These projecting filaments, measuring $\frac{1}{10000}$ inch in length, are of extreme delicacy, and take their origin at a distance about equal to one-half their length below the distal extremity of the trichocyst. Their direction is not always at right angles to their support, but frequently, even in those of the same individual, they project upward or downward, or form

angles of various degrees. It is probable that these radiating appendages are not constituent parts of the trichocyst when within the body of the infusorian, but that they are formed at the moment of their violent extrusion, and consist of minute shreds of the cuticular surface torn away by the suddenness and quickness of their passage. If this supposition be correct it is then difficult to explain the very uniform length of these fine, filamentous threads.

Reproduction takes place by transverse fission. The cilia of the comb-like adoral series unite laterally and form a membrane. The anterior cilia of the sinus unite with it and lengthen the membrane to the front, the newly-formed tissue being widest somewhat in advance of its centre, and narrowing toward both ends. The animal then separates across the middle, forming two Holotrichous creatures, each with a perfectly smooth, unwrinkled membrane vibrating somewhat obliquely along the centre of its ventral surface, the free edge of this tip-tilting tissue being distinctly and strongly thickened.

The ciliary appendages are formed, after transverse fission of the infusorian's body, by a repeated splitting of this membrane. The ciliary fringes unite to form the membrane, the membrane divides to form the fringes, the thickened edge of the membrane going into the thickened extremities of the adoral comb. The process of reproductive fission occupies two hours or less.

Family CYRTOLOPHOSIIDÆ, Stokes.

Animalcules ovate, persistent in form, entirely ciliate, temporarily free-swimming, or inhabiting singly a soft, mucilaginous domicile; adoral cilia setose, on the right-hand margin of a ventral, longitudinal adoral groove or depression at the posterior extremity of which is situated the oral aperture; the anterior extremity bearing a tuft of long, curved, vibratile cilia; anal aperture postero-terminal.

Genus CYRTOLOPHOSIS, Stokes.

Animalecules ovate, the anterior extremity bearing a fascicle of long, distally curved, vibratile hairs; secreting and inhabiting a variously modified, mucilaginous, granular zoöcytium, to which they are in no way attached and from which they may pass at will; oral aperture at the posterior extremity of an excavated, elongated groove, longitudinally traversing the anterior part of the ventral surface, bearing on its right-hand margin a series of cirrose, adoral cilia; nucleus and contractile vesicle single, conspicuous; anal aperture postero-terminal.

CYRTOLOPHOSIS MUCICOLA, *Stokes.* Pl. VI, fig. 1.

Cyrtolophosis mucicola. Stokes: Am. Nat., xix, May, 1885.

Body ovate, two and one-half to three times as long as broad, both extremities rounded, narrowed anteriorly, the ventro-frontal border obliquely truncate; anterior cilia longest, those of the general surface setose, the anteriorly placed fascicle of distally and downwardly curved cilia conspicuous; adoral depression extending from the frontal border for one-third the length of the entire body; adoral cilia cirrose, curved, diminishing in length toward the oral aperture; contractile vesicle single, spherical, posteriorly placed near the right-hand lateral border; nucleus subspherical, subcentrally located. Length of body $\frac{1}{900}$ to $\frac{1}{1000}$ inch. Zoöcytia solitary or variously united. Habitat.—An infusion of dead leaves. Reproduction by transverse fission.

The sheath or zoöcytium is very soft and shapeless, and variable both in size and in number of its occupants. It appears to be formed primarily by a thin exudation from the creature's body that would be nearly invisible were it not for the extraneous particles, spores, bacteria and debris of all kinds that adhere to the surface, and especially for the zoöid's excrementitious matter, which seems to be the principal building material and the cause of the coarsely granular aspect. It is not uncommon

to find a small colony produced by the mutual union, and probably by a mutual formation of adjacent zoöcytia, the resultant of this adhesion being a nondescript mass of flocculent matters from under shelter of which the animalecules project, and when startled by the approach of a larger infusorian, or from other cause, quickly glide backward to the posterior part of their semi-transparent dwelling. These zoöcytia are frequently attached to vegetable fragments, or to masses of residual detritus, so that they would be an almost indistinguishable part of the granular aggregation were it not for the presence of the living infusorian. Indeed, when deserted, these formations cannot be separated by the eye from other flocculent clusters so often in the field. Yet the creature forms them, apparently involuntarily, for soon after a temporarily free-swimming zoöid comes to rest, rejected particles in the food-bearing current begin to mark the outlines of the mucilaginous excretion, which soon increases in size by the adhesion of everything that touches it.

The cluster of long hairs on the frontal border are in almost constant vibration, and by their rapid downward lashing seem to force a current into the adoral groove and against the row of strong setose cilia bordering the right-hand margin of the adoral groove.

Family SPIROSTOMIDÆ, S. K.

Genus APGARIA, Stokes.

Body irregularly ovate, more or less flattened or lamellate, entirely ciliate, soft, flexible, transparent and somewhat changeable in form; the anterior extremity slightly curved toward the left-hand border, and terminating in a more or less beak-like apex; the posterior extremity with a retractile tail-like prolongation; the right-hand body-margin convex, the left-hand border somewhat sigmoid and bearing an elongate-ovate groove or depression extending backward and obliquely inward, the oral aperture being at its posterior widest and deepest part;

pharynx tubular, anteriorly curved, expansile and ciliated; the left-hand edge of the peristome field bearing a single row of long vibratile adoral cilia continued around the mouth and into the pharynx, the basal portion of the right hand margin occupied by a conspicuous, lamellate, undulating membrane; cuticular cilia fine, clothing the longitudinal surface furrows; nucleus moniliform or rounded, subcentrally located; contractile vesicle single or double, posteriorly placed; anal aperture posterior, near the pulsating vacuole.

APGARIA UNDULANS, *Stokes*. Pl. VI, fig. 2.

Apgaria undulans. Stokes: Am. Jour. Sci., July, 1884.

Body leaf-like and lamellate, longitudinally furrowed, the length twice to two and one-half times the breadth; anterior extremity terminating in a rounded, beak-like projection directed toward the left-hand border; the right-hand margin usually evenly convex and continued through a sinistrally directed concavity into the tail-like prolongation, the whole border thus presenting an elongated S-shaped outline; the left-hand margin somewhat sigmoid and continued into the tail-like prolongation through a sinistrally directed convexity; the posterior tail-like prolongation retractile to a short, conical projection, but when extended, curved toward the right-hand border and forming about one-third of the entire length of the body; cuticular cilia long and fine; peristome field a long channel, occupying somewhat less than the anterior two-thirds of the left-hand border, taking its origin at a short distance posteriorly to the beak-like apex, the margin bearing the adoral cilia somewhat elevated, its outline sigmoid, its free edge conspicuously thickened; adoral cilia long, continued around the mouth and into the narrow, ciliated, anteriorly curved pharynx; the undulating membrane large, delicate and very flexible, its base of attachment extending obliquely within the adoral channel to near the posterior margin of the oral aperture; nucleus conspicuous, moniliform,

more or less sigmoid, obliquely and subcentrally placed, usually composed of from four to seven nodules; contractile vesicle single, spherical, posteriorly located near the left-hand border at the base of the tail-like prolongation; endoplasm colorless, vacuolar, a large and conspicuous vacuole usually apparent beside the contractile vesicle. Length of body $\frac{1}{200}$ inch. Habitat.—Standing water, commonly near the bottom.

It has given the writer pleasure to name the genus to which this noble infusorian belongs, to his learned friend, Mr. Austin C. Apgar, Professor of Zoölogy in the New Jersey State Normal School.

APGARIA ELONGATA, *Stokes*. Pl. VI, figs. 3 and 4.

Apgaria elongata. Stokes: Am. Jour. Sci., July, 1884.

Body elongate-ovate, compressed, from three to four times as long as broad; beak-like apex distinct; posterior region continued as a centrally directed, acute, conical, tail-like prolongation, which, when extended, is about one-fifth the entire length of the body; peristome field occupying the anterior one-half of the left-hand border, its margins scarcely sigmoid, and not conspicuously elevated; the adoral ciliary fringe originating at a short distance posteriorly to the beak; undulating membrane wide, attached to the basal one-half of the right-hand margin of the peristome channel, its insertion not conspicuously oblique and not surrounding the mouth; pharynx short, ciliated; nucleus elongate-ovate, in the anterior body-half near the left-hand border; contractile vesicles two, situated at the base of the tail-like projection, and contracting alternately. Length of body $\frac{1}{350}$ to $\frac{1}{300}$ inch. Habitat.—The surface of water-soaked twigs and decaying leaves at the bottom of shallow pools.

Figure 3 represents this infusorian with the tail-like prolongation partially withdrawn, as most commonly seen; figure 4, an outline of the same part extended. Its movements are the most rapid, and its changes of form the greatest of any member of the genus yet met with. The body is very flexible,

and is frequently twisted temporarily. Reproduction takes place by transverse fission.

APGARIA OVATA, *Stokes*. Pl. VI, figs. 5 and 6.

Apgaria ovata. Stokes: Am. Jour. Sci., July, 1884.

Body irregularly ovate, the length once and one-half to twice the breadth, the posterior region somewhat inflated, the anterior compressed, the beak-like apex short, acute and inconspicuous or obsolete; the posterior extremity usually rounded, and the short, acute, conical tail-like prolongation entirely retracted; peristome field occupying the anterior three-fourths of the left-hand border, its margins sigmoid, not elevated; the adoral ciliary fringe originating at the anterior apex; undulating membrane narrow, attached to the basal third of the right-hand border of the peristome field, not obliquely inserted and not surrounding the oral aperture posteriorly; nucleus ovate, situated in the anterior body-half near the left-hand border; contractile vesicles two, posteriorly placed, pulsating alternately; anal aperture large, in close proximity to the contractile vacuoles. Length of body $\frac{1}{200}$ inch. Habitat.—The surface of submerged twigs and decaying leaves, at the bottom of shallow pools.

The tail-like prolongation of this form is the shortest of any yet observed, and an individual in any other than the retracted state represented in figure 5 is uncommon, although the infusorians are not rare. It is also the least changeable in form, a slight elongation of the body being about the extent of its alteration. When in motion, like the others, it rotates on its longitudinal axis, but not rapidly. The animalcule frequently remains motionless in the field of the objective, either feeding or awaiting the result of its ciliary currents. Its appetite is voracious; spores, unicellular Algæ, small infusorians, diatoms, almost any minute living thing, seeming acceptable. The undulating membrane is active in the feeding process, waving and bending across the oral fossa and forming the roof of a food-trap which, if occasion demands, descends and thrusts the morsel

into the mouth. The anal aperture is remarkably large and, at times, is temporarily conspicuous as a postero-terminal depression with a puckered margin. It frequently opens in connection with the pulsating vacuoles, a great part of the creature's posterior extremity then appearing to give way, beaded threads of sarcode sometimes streaming into the water, and rapidly receding. The pulsating vacuoles after contraction are followed by several internal well-marked sarcode threads or folds, which gradually fade away to re-appear after the next pulsation.

Reproduction takes place by longitudinal fission.

BOTHROSTOMA, *Stokes*.

Animalcules free-swimming, ovate, soft and flexible; peristome field a more or less obliquely directed longitudinal depression, situated on the left-hand side of the body, extending beyond the body-centre, and continued inward as a short, ciliated, pharyngeal passage; the left-hand border of the peristome bearing a series of large cilia, the posterior portion of the right-hand margin supporting an undulating membrane; a cluster of long setose cilia projecting from the posterior extremity; contractile vesicle and nucleus conspicuous; anal aperture postero-terminal. Inhabiting fresh water.

BOTHROSTOMA UNDULANS, *Stokes*. Pl. V, fig. 6.

Bothrostoma undulans. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body ovate, about two and one-half times as long as broad, colorless, soft and changeable in shape, the anterior extremity obtusely pointed, the posterior border truncate; cuticular surface longitudinally striate, peristome field extending obliquely inwards beyond the body-centre; undulating membrane large, often resembling a long anteriorly curved seta, extending from the oral aperture to within one-third of the body-length of the anterior extremity; oral aperture at the posterior termination of the peristome, ovate; pharynx short, ciliate, infundibuliform;

posterior setose cilia long and conspicuous; nucleus ovate, situated in the anterior body-half; contractile vesicle large, single, spherical, placed near the posterior extremity. Length of body $\frac{1}{265}$ inch. Habitat.—Standing pond-water.

Genus SPIROSTOMUM, Ehr.

SPIROSTOMUM TERES, C. & L.

Spirostomum teres. Stokes: Jour. Trenton Nat. Hist. Soc., Jan., 1886.

Conjugation takes place by union of the entire length of the peristome field. Reproduction is by transverse fission.

SPIROSTOMUM AMBIGUUM, Ehr.

SPIROSTOMUM LOXODES, Stokes. Pl. VI, fig. 7.

Spirostomum loxodes. Stokes: Am. Jour. Sci., April, 1885.

Body elongate-fusiform, flattened, from six to seven times as long as broad, widest centrally, slightly tapering toward both extremities, the anterior region rounded, curved toward the right-hand side and terminating in a short, beak-like projection, the posterior body-margin truncate; cuticular surface obliquely striate; cilia of the anterior and posterior borders more conspicuous than those on the general surface; peristome field occupying about one-third of the body-margin; nucleus moniliform, the nodules ovoid; contractile vesicle extending through the entire length of the right-hand border as a narrow canal-like channel, terminating posteriorly in a conspicuous dilatation; anal aperture postero-terminal. Length of body $\frac{1}{85}$ to $\frac{1}{75}$ inch. Habitat.—Pond-water, in Western New York.

In external contour this creature bears a striking resemblance to *Loxodes*, and might readily be mistaken for a member of that genus if casually examined with a low power of the microscope. In its own genus it approaches nearest to *Spirostomum teres*, C. & L., which is without the acutely pointed sinistral curvature of the frontal margin, the former species differing also in the presence of the moniliform nucleus instead of a single ovoid

nodule, as well as in the proportion borne by the body width to its length.

Reproduction takes place by transverse fission, probably subsequent to conjugation, as individuals have been repeatedly obtained in the latter condition, the union, as observed, being effected by the mutual adhesion of the peristome fields throughout their entire length.

Genus LEUCOPHRYS, *Ehr.*

LEUCOPHRYS EMARGINATA, *Stokes*. Pl. VI, figs. 8 and 9.

Leucophrys emarginata. *Stokes*: Jour. New York Micros. Soc., June, 1885.

Body pouch-shaped, depressed, about one and one-half times as long as broad, soft and flexible but persistent in form, the extremities subequal in width, the dorsal surface convex, the ventral flattened; the posterior extremity obliquely rounded, conspicuously emarginate at the left-hand side of the median line, the anterior margin obliquely truncate, deeply concave, the angles rounded, the right-hand border considerably prolonged beyond the frontal region, the left-hand body-margin slightly flattened, the right-hand side convex; cuticular surface obliquely striate, minutely roughened; cuticular cilia fine, arranged in oblique longitudinal rows, those of the posterior extremity supplemented by numerous, longer, less rapidly vibrating filaments; peristome field wide, deep, confined to the anterior third of the ventral surface, broadest anteriorly, the apical extremity rounded and curved toward the right-hand side, the dextral border straight, occasionally somewhat concave, over-arching the deeply and laterally excavated peristome field; oral aperture capacious, broadly ovate; endoplasm crowded with green, apparently disciform, chlorophyll corpuscles arranged somewhat regularly in oblique longitudinal lines; contractile vesicle single, spherical, postero-terminal, on the left-hand side of the median line; nucleus long, band-like, convolute, placed in the anterior body-half; anal aperture large, in close proximity to the contractile vesicle. Length of body $\frac{1}{150}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

The supplementary hairs clothing the posterior extremity and restricted to it, are from two to three times longer than those of the general surface. They appear to originate from the posterior striations, as do the shorter ones, and to have a less rapid and more independent movement.

The chlorophyll corpuscles within the ectoplasm are so numerous that they are in contact, thus forming an almost continuous subcuticular layer. According to Brandt's doctrine of animal and vegetable commensalism, or double parasitism, these chlorophyll corpuscles, which are presumably subspherical, are not mere collections of pigmentary matter, but true unicellular Algæ living a parasitic life so far as their position and their absorption of the excreted products of the host are concerned, and at the same time compelling that host to play the rôle of parasite in appropriating the products elaborated by the plants.

In the present example the subcuticular symbiotic Algæ form, as stated, an almost continuous sheet of vivid-green corpuscles, as a rule completely obscuring the internal structure of the infusorian. The endoplasm, however, is colorless and, when forced out by pressure, or when set free by diffuence after the creature's death, is seen to enclose numerous angular and colorless plates mingled with many smaller granules of similar character, the largest being perhaps two or three times the size of the presumably symbiotic Algæ. These endoplasmic plates (figure 9) are flat, irregular, structureless, and somewhat refringent; they are probably amylaceous. If, therefore, we may judge from the form, position, and arrangement of the chlorophyll corpuscles, they would seem to present an excellent example of symbiosis. But the statement is made that "the animals (Phytozoa, as they may be termed) renounce their independent life and allow themselves to be entirely supported by their parasites, when once the green or yellow Algæ have entered their tissues and have multiplied there sufficiently. They absorb no more solid organic substances, although they are perfectly able to do so, but are entirely comparable, from the mor-

phological point of view, to animals devoid of chlorophyll. This life of Algae in common with animals is one of the strangest things which can be conceived. Morphologically it is the Algae which are the parasites, but physiologically the animals." So far as some, at least, of the Infusoria are concerned, the truth of this statement seems doubtful. *Leucophrys emarginata* is a case in point. The enclosed chlorophyll corpuseles, the symbiotic Algae, if they are such, could hardly be more abundant, unless the entire sarcode should be filled with them. They certainly appear to be sufficiently multiplied, yet the infusorian is voracious. It gorges itself with diatoms. Small Infusoria are eagerly accepted, and, in one instance, I have witnessed the capture of a full-sized *Paramaccium aurelia*, Müll., which, although visible to the naked eye, was powerless to resist the current that swept it down the peristome field and through the capacious oral aperture. The excrementitious matter forms a correspondingly large mass of empty diatom frustules, fragmentary remains and granules, surrounded by a colorless protoplasmic envelope.

LEUCOPHRYS CURVILATA, Stokes. Pl. VI, fig. 10.

Leucophrys curvilata. Stokes: Am. Monthly Micros. Jour., vii, May, 1886.

Body ovate, from once and one-half to twice as long as broad, slightly widest posteriorly, somewhat curved toward the left-hand side, the right-hand border longest, the left-hand margin anteriorly concave; the dorsal surface convex, the ventral flattened; anterior border obliquely excavate, the posterior evenly rounded; cuticular surface longitudinally striate; cilia of the posterior border longest and most conspicuous; peristome field extending through the anterior one-fourth of the ventral aspect; oral aperture ovate; pharyngeal passage long, tubular, curving toward the right-hand side and extending to the centre of that border, apparently ciliated; nucleus band-like, convolute, sub-central; contractile vesicle posteriorly placed, with a canal-like diverticulum extending to the centre of each lateral border; endoplasm colorless, transparent, or containing numerous dark

granules; anal aperture in close proximity to the contractile vesicle. Length of body $\frac{1}{150}$ to $\frac{1}{200}$ inch. Habitat.—Standing water, with decaying vegetation.

Occasionally a posteriorly developed emargination is temporarily developed, due probably to the position of the anal aperture. Conjugation has been frequently observed, union taking place by means of a portion of the antero-ventral region, and apparently involving the oral aperture, the zooids then swimming with the ventral surfaces parallel. No trace of the animal chlorophyll which so crowds the subcuticular region of *L. emarginata*, is here visible, the endoplasm being almost hyaline.

Family STENTORIDÆ, Stein.

Genus STENTOR, Oken.

STENTOR GLOBATOR, *Stokes*. Pl. V, figs. 17 and 18.

Stentor globator. Stokes: Am. Monthly Micros. Jour., vi, Oct., 1885.

Body subspherical, changeable in form, free-swimming or temporarily adherent by a long, narrow, retractile, tail-like prolongation protruded from the centre of the posterior extremity; peristome field elevated, rounded, finely ciliated in concentric circles; cuticular cilia fine, longest posteriorly arranged in longitudinal lines; hispid setæ long and numerous, extending at right angles to the general surface; nucleus not observed; contractile vesicle double, spherical, posteriorly located. Diameter of the body $\frac{1}{300}$ inch. Habitat.—Still water, with *Myriophyllum*.

This remarkable *Stentor* widely differs from any hitherto observed, possessing some characteristics that will necessitate changes in the generic diagnosis as formulated by Kent. Most members of the genus are noted for the ease with which they change their shape, the alteration, however, being confined chiefly to a contraction and consequent change in the form of the entire body. Several species have been observed with very fine pseudopodic filaments emitted from the posterior extremity, but none, so far as I am aware, have been recorded with the

peculiar ability which *S. globator* possesses of posteriorly protruding a soft, flexible, attenuate tail-like prolongation equal in length to the diameter of the body, to be subsequently entirely withdrawn, and again protruded when the exigencies of the situation demand. The appearance of this temporary caudal prolongation brings to mind a pseudopodic protrusion, since it has the ability to somewhat alter its contour by the formation of several irregularly distributed enlargements which may be speedily absorbed, the part then becoming a long, simple, attenuate prolongation, the extreme tip of which forms the easily detachable point of support for the body. The entire tail-like part seems to be covered by a cuticulum similar to that of the zoöid, and is ciliated. When about to be absorbed or withdrawn into the body, it becomes very flexible, being flourished and curved and twisted in an amusing manner. Both protrusion and absorption are accomplished rapidly. If this caudal prolongation is present, the convex peristome field is conspicuously flattened, the body is narrowed and lengthened, and only at this time does the infusorian present any resemblance to the trumpet-like form so commonly assumed by other members of the genus. The entire body is soft and changeable in shape. Even when the tail-like part is not protruded, the infusorian then being a free-swimming animalcule, the changes are quite marked and extensive.

The cirri composing the peristomal fringe are large and numerous. When at rest each one presents an appearance remotely similar to that of the adoral ciliary wreath in *Tintinnidium semiciliatum*, where each cilium is distally pectinated. After careful scrutiny, however, I have been unable to demonstrate the existence of such structure. The appearance is probably due to a confused image of the intermingling adoral cirri and the finer cilia of the peristome field. The last-named part is much more convex and more elevated than in *Stentor* generally, and the infusorian seems to have the amount of convexity under quite complete control.

The cuticular setæ are long and numerous. They are more conspicuous and apparently more abundant anteriorly than on the posterior parts. They also seem to vary in length in the same row, but the appearance may be due to the convexity of the cuticular surface.

The double spherical contractile vesicles are uncommon in the genus. Their existence in the present species would afford a ready clue to its identification, if anything more were needed than the peculiar form of the body, and the characteristic changes of the posterior extremity.

STENTOR POLYMORPHUS, (Müll.) Stein.

STENTOR RÆSELLII, Ehr.

STENTOR BARRETTI, Barrett.

STENTOR CÆRULEUS. Ehr.

Stentor cæruleus. Worcester: Proc. Central Ohio Sci. Assoc., i, Pt. 2, No. 1, 1884.

Stentor cæruleus. J. W.: Am. Monthly Micros. Jour., v, March, 1884.

Prof. G. W. Worcester (*loc. cit.*) gives a detailed description of his observations on the life-history of this species. The changes seemed to originate in a motionless, intensely blue mass, in which the moniliform nucleus and a large vacuole were plainly visible. This mass soon began to slowly change its form, cilia were developed at each end, the cilia finally disappearing from one extremity, and the blue mass, after many alterations of shape, rapidly swimming from the field of view. "While swimming around it was met suddenly by another specimen, and after each had gone through a series of approachings and retreats, they finally came together in apparent conjugation, each fastening itself by its posterior end to some object, their backs meeting, when they would roll over each other till their anterior ends met. This conjugation lasted some moments, when they became detached and swam away in opposite directions," one becoming bronze in color, and the endoplasm assuming rapid flowing movements. Again, the infusorian suddenly

became flat and spread out, large vacuoles appearing throughout the entire mass. Its appearance was now *Amœba*-like, and the endoplasmic streaming rapid. A granular mass was soon detached and immediately became globular, with a slowly rotatory motion, and a second globular portion was thrown off from the main body, which was now vacuolar, nearly colorless and contained numerous egg-like masses filled with a greenish-blue liquid. The small globular formations were lost, and the main mass was not observed further, but similar results were obtained from other specimens. Later, in a new preparation, Prof. Worcester found "a globular mass, which, to all appearance, was in exactly the same stage as that of the three masses put off from the specimen the evening before." This became rotatory, a vacuole was visible "which afterwards developed into the mouth," cilia were developed, and it finally swam away. Two mature individuals became diffuent, the granular endoplasm flowing out and leaving a row of dense, dark-colored egg-like bodies, which, for several hours, presented no change.

The writer would here suggest that all the above changes were due to the inauspicious and painful surroundings of the infusorian. Similar occurrences are readily observable when other species of *Stentor* are confined within a limited space, and subjected to undue pressure of the cover glass, and absence of a sufficient oxygen supply. And the row of egg-like bodies which escaped from the diffuent endoplasm, I would further suggest to be the nodules of the moniliform nucleus, and the ciliated bodies to be separated portions of the ciliated cuticular surface. The cilia of the general surface are extremely fine; on the globular masses they were not seen with the seven-eighths inch objective used by Prof. Worcester, being noticed by him only while employing a one-fifth inch. There seems, therefore, no reason to assume that the cilia were newly developed on the globular masses after they had become separated from the mature *Stentor*, nor on the ends of the flattened *Amœba*-like blue mass.

Prof. Worcester also confirmed the statements of previous observers in reference to the formation of embryos from the nucleus, and reproduction by oblique fission.

In the *American Monthly Microscopical Journal*, March, 1884, "J. W." claims to have observed that "the blue *Stentor* not only takes small food-particles through the oral aperture, but that it has the means of projecting portions of its protoplasm to serve the purpose of capturing its prey, for the rotifers and *Paramaccia*, under observation, were slowly drawn into the body, still surrounded by a transparent envelope, and were gradually absorbed. All movements of the prey ceased when caught by the Rhizopod-like extension of the *Stentor*." Prof. D. S. Kellicott (*Proc. Am. Soc. Micros.*, 1884,) remarks that he has no confirmatory evidence as to the correctness of J. W.'s statements, but that he has seen enough of the plastic nature of this *Stentor* to convince him that J. W.'s assertions may be credible.

STENTOR AMETHYSTINUS, *Leidy*.

Stentor amethystinus. Leidy: *Proc. Acad. Nat. Sci. Phila.*, 1880.

This occurs sparingly in the writer's locality.

STENTOR IGNEUS, *Ehr.*

STENTOR NIGER, *Ehr.*

Family TINTINNIDÆ, *S. K.*

Genus TINTINNIDIUM, *S. K.*

TINTINNIDIUM SEMICILIATUM, (*Sterki*) *S. K.*

Tintinnidium semiciliatum. Stokes: *The Microscope*, iv, May, 1884.

Genus STROMBIDINOPSIS, *S. K.*

STROMBIDINOPSIS ACUMINATA, *Stokes*. Pl. VI, fig. 12.

Strombidinopsis acuminata. Stokes: *Am. Monthly Micros. Jour.*, vii, May, 1886.

Body elongate-ovate, subcylindrical, slightly constricted anteriorly, less than three times as long as broad, somewhat gibbous

posteriorly, that extremity terminated by a short, conspicuous, eccentric acumination; anteriorly somewhat laterally curved, the frontal border centrally elevated, the oral aperture surrounded by a slight depression and followed by a conical, longitudinally plicate pharynx; adoral ciliary wreath circular, the cilia but slightly longer than those of the general surface; contractile vesicle near the posterior extremity; endoplasm granular. Length of body $\frac{1}{4.50}$ to $\frac{1}{6.50}$ inch. Habitat.—Standing water, with decaying vegetation from South Florida.

Usually the prominent acumination projects abruptly from the rounded extremity; with other individuals from the same infusion the part more gradually tapers from the body. The movements of the zoöid are rapid, irregular, and difficult to follow. The structure can be satisfactorily studied only after death by poisoning, or when the animalcule is taking food. In the latter case the body is shortened and broadened, while the oral aperture is greatly dilated, easily engulfing, as repeatedly witnessed, the comparatively large *Chilomonas paramaecium*, Ehr.

STROMBIDINOPSIS SETIGERA, Stokes. Pl. VI, fig. 11.

Strombidinopsis setigera. Stokes: Am. Monthly Micros. Jour., vi, Oct., 1885.

Body obconical, twice as long as broad, finely striate longitudinally; widest at the frontal border, beneath which it is constricted, tapering thence to the rounded posterior extremity; peristomal cilia abundant, curving outwardly, their length not exceeding one-half the greatest width of the body; a series of fine, outwardly directed, hair-like setæ projecting from the cuticular surface behind the peristome border, their length equalling one-half the length of the zoöid; pharyngeal passage wide, ciliate, extending to the centre of one lateral body-margin; endoplasm colorless, transparent; contractile vesicle single, spherical, posteriorly located. Length of body $\frac{1}{4.50}$ inch. Habitat.—Pond-water.

This differs from *S. gyrans*, S. K., from English waters,

chiefly in the shortness of the peristomal cilia and the length and presence of the fine setæ springing from the anterior surface. Its movements are rapid and erratic. It has the habit of frequently darting backward for a short distance, at the same time contracting the frontal portion and partially closing the peristome field, the adoral cilia being thrown inwards, some of them arching above the oral region, the frontal setæ then being almost parallel and directed forwards.

Family CALCEOLIDÆ, *S. K.*

Genus CALCEOLUS, *Diesing.*

CALCEOLUS CYPRIPIEDIUM, (*J.-Clk.*) *S. K.*

Observed in this country only by Prof. H. James-Clark, its discoverer.

ORDER PERITRICHÆ, *Stein.*

Family HALTERIIDÆ, *C. & L.*

Genus HALTERIA, *Duj.*

HALTERIA GRANDINELLA, (*Müll.*) *S. K.*

Genus STROMBIDIUM, *C. & L.*

STROMBIDIUM CLAPAREDI, *S. K.*

Strombidium Claparedi. Kellicott: *Proc. Am. Soc. Micros.*, 1885. •

STROMBIDIUM GYRANS, *Stokes.* Pl. VI, figs. 15 and 16.

Strombidium gyrans. Stokes: *Jour. Royal Micros. Soc.*, Feb., 1887.

Body turbinate or obconical, less than twice as long as broad, the lateral border of the frontal margin with a conspicuous rounded elevation, the posterior extremity tapering and truncate; cuticular surface smooth, except at the posterior region, where there are a few longitudinal ridges which often extend slightly beyond the termination of the body; contractile vesicle apparently double, one large and situated laterally near the posterior extremity, the other (?) smaller and near the frontal border;

nucleus long, band-like, transversely placed close to the anterior extremity. Length of body $\frac{1}{450}$ inch. Habitat.—Standing pond-water.

The movements are extremely rapid and erratic, the animalcule darting through the water by revolution on the longitudinal axis so rapidly as to defy examination. Fortunately, however, it has the habit of temporarily attaching itself to some supporting object, by means of its posterior extremity, when it becomes comparatively quiescent; but even then it rotates on its long axis. At other times it swings to and fro in the field, describing a long curved path through the water, as though it were attached to the end of a restraining but invisible thread.

This infusorian may readily be distinguished from all other known species of the genus by the long, band-like nucleus, an organ of this form not having been recorded as belonging to any previously described *Strombidium*.

I have not been able to positively demonstrate the presence of two contractile vesicles. The creature's movements are so rapid and erratic that the study is difficult under any circumstances, but to observe a small, laterally developed pulsating vacuole while the infusorian is rotating and continually carrying the organ beyond the focus, is well-nigh impossible. The posteriorly located vesicle is large and seen with comparative ease.

STROMBIDIUM OBLONGUM, *Kellicott*.

Strombidium oblongum. Kellicott: Proc. Am. Soc. Micros., 1885.

Body oblong, subcylindrical, smooth; anteriorly somewhat constricted beneath the peristome, the posterior border rounded; oral cirri powerful, their length equalling one-half that of the body; several fine, scattered, trailing setæ attached to the posterior body region, equalling in length that of the zoöid; a few fine cilia centrally located, presumably on the ventral surface; contractile vesicle spherical, anteriorly situated; nucleus not observed; endoplasm transparent, usually enclosing several green

corpuscles. Dimensions not recorded. Habitat.—Pond-water, with aquatic plants and the mucilaginous Alga, *Chaetophora elegans*.

Genus MESODINIUM, Stein.

MESODINIUM FIMBRIATUM, Stokes. Pl. VI, fig. 14.

Mesodinium fimbriatum. Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Body divided into two unequal, subglobose regions by a transverse groove, from which springs the girdle of setose cilia, each of these appendages being distally cut into three or more unequal branches; cuticular surface obliquely and finely striate, so that the margins of the body, when examined from either extremity, present a crenulated outline; contractile vesicle large, spherical, located at one side near the posterior extremity. Length of body $\frac{1}{1125}$ inch. Habitat.—Standing pond-water. Movements rapidly rotatory, with frequent lateral leaps.

The distinctly fimbriated condition of the locomotive cilia at once separates this from all previously known species.

In company with this interesting form there was present a *Mesodinium* corresponding in all essential characters with *M. pulex*, C. & L., a species hitherto recorded from salt water alone. The only noticeable difference was in the size, the fresh-water variety being somewhat larger than the marine. The cilia of *M. pulex* are not fimbriated.

MESODINIUM RECURVUM, Kellicott. Pl. V, fig. 21.

Mesodinium recurvum. Kellicott: Proc. Am. Soc. Micros., 1885.

Body globose, smooth, the snout-like process short; oral cilia long and fine; locomotive cilia encircling the body horizontally at about one-third the length of the body from the anterior extremity; contractile vesicle single, situated near the centre of one lateral border; nucleus oval, subcentral; endoplasm usually enclosing a few large green corpuscles. Dimensions not recorded. Habitat.—Pond-water, with Algæ, in early spring. Movements rapid, with sudden lateral leaps.

Family GYROCORIDÆ, Stein.

Genus GYROCORUS, Stein.

GYROCORUS OXYURA, Stein.

Genus BALANITOOON, Stokes.

Animalcules free-swimming, ovate or subpyriform, persistent in form, not cuirassed, the anterior portion of the cuticular surface clothed with vibratile cilia, the posterior region naked; oral aperture apical, without larger adoral cilia; pharynx apparent; a single postero-terminal seta present; animalcules leaping as well as swimming. Inhabiting fresh water.

The ciliation of the anterior one-half or two-thirds of the cuticular surface, the absence of a series of differentiated oral cilia, and the reduction in the number of the springing hairs to one, and that one on the posterior extremity of the body, exclude this remarkable infusorian from the Halteriidæ of Claparède and Lachmann. Its ordinal position, the writer supposes, is among the Peritricha, although there is at present no type known in that infusorial order to which it bears a resemblance, the extensive ciliation of the anterior region and the absence of distinct oral cilia being characteristic of *Balanitooon* alone. Only a slight effort of the imagination is needed to further suggest that this form is connectant or transitional between the Holotricha and the Peritricha, the presence of cilia on the posterior body region being alone needed to relegate the creature to the former order, and the development of distinctly differentiated adoral cilia, in addition to the cuticular series now existing, being only necessary to admit it as an undoubted member of the Peritricha. Its peculiar springing or leaping movements call to mind the similar saltatory efforts of *Halteria*. Occasionally a depression is formed around the body at a short distance from the posterior extremity, when the little creature not remotely resembles an acorn in its cup, an appearance that suggested the generic name.

BALANITOOZON AGILE, Stokes. Pl. V, fig. 19.

Balanitoozon agile. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body conical or subpyriform, less than twice as long as broad, widest and truncate posteriorly, thence tapering to the frontal border; the anterior two-thirds only of the cuticular surface clothed with long adcurved cilia; posterior terminal seta subequal to the body in length, its distal extremity usually curved; oral aperture apical; anal opening not observed; contractile vesicle single, spherical, situated near one side of the posterior border; nucleus small, subspherical, placed near the centre of one lateral margin; endoplasm colorless, often granular posteriorly, and enclosing colored food particles; movements rotatory on the longitudinal axis, with frequent and violent lateral leaps. Length of body $\frac{1}{1800}$ inch. Habitat.—Standing water, with *Sphagnum*. Reproduction by transverse fission.

The cuticular cilia appear to be disposed in distinct parallel circles, not in the spirals so common to the Peritricha. Neither is there any sign of the peritrichous arrangement of an anterior or adoral ciliary wreath where one arm of the spiral descends into an oral fossa, since no fossa exists here, the oral aperture being a minute orifice followed by a short but distinctly visible pharyngeal passage. The cilia are comparatively long and are usually curved towards the frontal extremity.

The movements, in addition to the sudden lateral leaps, which are presumably caused by the action of the postero-terminal seta, are rapid and erratic. Reproduction is by transverse fission, the springing seta being developed from the posterior portion of the anterior moiety, and projecting obliquely from and beyond the deepening constriction for a long time before the final separation of the animalcules.

BALANITOOZON GYRANS, Stokes. Pl. V, fig. 20.

Balanitoozon gyrans. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body ovate, about twice as long as broad, widest near the centre, thence tapering anteriorly, the borders rounded, the

postero-lateral margins flattened, nearly straight, the body slightly narrowed at the truncate posterior extremity; oral aperture central, projecting; cilia clothing the anterior two-thirds of the body; posterior seta single, subequal to the body in length; pharyngeal passage usually conspicuous; contractile vesicle single, placed at one side of the posterior extremity; cuticular surface apparently transversely striate. Length of body $\frac{1}{2000}$ to $\frac{1}{1500}$ inch. Habitat.—Standing pond-water. Movements by rapid revolutions on the longitudinal axis, with sudden lateral leaps. Reproduction by both transverse and longitudinal fission.

Genus UROCENTRUM, Nitzsch.

UROCENTRUM TURBO, Müll. sp.

Family URCEOLARIIDÆ, Stein.

Genus TRICHODINA, Ehr.

TRICHODINA PEDICULUS, Ehr.

Genus URCEOLARIA, Stein.

URCEOLARIA MITRA, Stein.

Observed on *Phagocata gracilis*, Leidy, by Mr. H. E. Valentine, of Boston.

Family VORTICELLIDÆ, Ehr.

Sub-Family VORTICELLINÆ.

Genus GERDA, C. & L.

GERDA VERNALIS, Stokes. Pl. VI, fig. 17.

Gerda vernalis. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body soft, elongated, from six to seven times as long as the widest part, the anterior two-thirds subcylindrical, the posterior one-third somewhat inflated, about twice as wide as the anterior region, the posterior extremity abruptly tapering and obtusely pointed; peristome border revolute; ciliary disc obliquely elevated, ciliary circles two, the anterior wreath a spiral; cuticular

surface finely striate transversely; nucleus long, narrow, band-like, perpendicularly placed near one lateral border; contractile vesicle spherical, situated in the inflated posterior region. Length, when fully extended, somewhat less than $\frac{1}{100}$ inch. Habitat.—Shallow ponds, in early spring.

The body of *G. vernalis* is rather longer in proportion to its width than is that of *G. fixa*, D'Udek., but the two closely resemble each other in form. The differences, however, are conspicuous. The cuticular surface of *G. fixa* is smooth, and the contractile vesicle is situated far forward. The body of *G. vernalis* is quite soft and flexible, and the endoplasm colorless and finely granular.

GERDA SIGMOIDES, Kellicott. Pl. VI, fig. 18.

Gerda sigmoides. Kellicott: Proc. Am. Soc. Micros., 1885.

Body irregularly elongate-ovate, soft and flexible, from four to six times as long as broad, the posterior one-third evenly ovate, tapering and subacuminate posteriorly, the anterior region narrowed into a neck-like, usually curved prolongation, forming about two-thirds of the entire length of the body; cuticular surface finely striate transversely; peristome slightly exceeding in width the diameter of the neck-like prolongation, the border somewhat thickened; ciliary disc moderately elevated; nucleus not observed; contractile vesicle single, spherical, situated in the ovate body-region near the origin of the neck-like prolongation; contracted body annulate at both extremities, occasionally longitudinally plicate posteriorly. Length of body $\frac{1}{180}$ to $\frac{1}{160}$ inch. Habitat.—Attached to confervæ from small ponds in Western New York.

Genus SCYPHIDIA, Duj.

SCYPHIDIA LIMACINA, Lach.

Observed by Prof. D. S. Kellicott attached to a small *Planorbis* from ponds near Buffalo, N. Y.

SCYPHIDIA OVATA, *Kellicott*. Pl. VI, fig. 19.*Scyphidia ovata*. Kellicott: Proc. Am. Soc. Micros., 1884.

Body ovate, less than twice as long as broad, attenuate posteriorly, slightly constricted beneath the peristome, the cuticular surface finely striate transversely; peristome border not everted; ciliary disc convex, slightly elevated, the width somewhat exceeding the width of the body; endoplasm granular; nucleus elongate, curved, situated in the anterior body-half near one lateral border. Length of body $\frac{1}{750}$ to $\frac{1}{600}$ inch. Habitat.—Attached to the cuticle of an aquatic worm.

SCYPHIDIA CONSTRICTA, *Stokes*. Pl. VI, fig. 20.*Scyphidia constricta*. Stokes: Am. Monthly Micros. Jour., vi, Oct., 1885.

Body elongate, gibbous, about three times as long as broad, constricted beneath the even, everted peristome border, widest near the centre, tapering posteriorly to the short intermedium of attachment; surface finely striate transversely; ciliary disc small, slightly elevated; contractile vesicle single, spherical, placed near the termination of the vestibulum; contracted body ovate, curved, strongly and transversely plicate on the concave side, the anterior border protruding as a conspicuous snout-like projection; parenchyma transparent, granular. Length of body $\frac{1}{450}$ inch. Habitat.—Pond-water; on *Nais*, often attached in pairs, or in clusters of three or four.

In contour this resembles *S. inclinans*, (D'Udek.) S. K., but it is readily recognized as a distinct form by the conspicuous anterior constriction, the more posterior position of the pulsating vacuole, and by the transversely striated cuticular surface. When contracted, although the two still resemble each other, they may be diagnosed by the presence, with *S. constricta*, of the prominent snout-like projection of the frontal border.

SCYPHIDIA FROMENTELLII, S. K.

Identified, with some doubt, by Prof. D. S. Kellicott, of Buffalo, on *Daphnia*, *Cyclops*, *Sida* and *Gammarus pulex*. (*Proc. Am. Soc. Micros.*, 1884.)

SCYPHIDIA INCLINANS, (*D'Udek.*) S. K.

Observed in abundance by Prof. D. S. Kellicott on a species of *Nais* from ponds near Buffalo. Under oblique illumination the cuticular surface is seen to be transversely striated. (*Proc. Am. Soc. Micros.*, 1884.)

Genus SPIROCHONA, Stein.

SPIROCHONA TENTINNABULUM, S. K.

Identified by Prof. D. S. Kellicott on the gills of the young of the spotted triton, *Diemyctylus viridescens*. (*Proc. Am. Soc. Micros.*, 1885.)

Genus RHABDOSTYLA, S. K.

RHABDOSTYLA OVUM, S. K.

RHABDOSTYLA CHÆTICOLA, Stokes. Pl. VI, fig. 21.

Rhabdostyla chæticola. Stokes: *Am. Monthly Micros. Jour.*, Aug., 1887.

Body elongate-ovate, somewhat changeable in shape, slightly gibbous, about four times as long as broad, widest centrally, constricted anteriorly beneath the peristome border, the posterior extremity narrowed to produce a subcylindrical prolongation about one-eighth as long as the entire body; peristome everted, not revolute, its width slightly exceeding that of the body; ciliary disc scarcely exerted; cuticular surface finely striate transversely; pedicle short, about one-eighth as long as the body, invaginate within the posterior extremity of the contracted zoöid. Length of body $\frac{1}{56}$ inch. Habitat.—Pond-water; attached to the dorso-lateral setæ of *Nais*.

RHABDOSTYLA INVAGINATA, *Stokes*. Pl. VI, fig. 22.

Rhabdostyla invaginata. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Body vasiform, often slightly gibbous, about one and one-half times as long as broad, widest centrally, tapering posteriorly to the pedicle, and anteriorly to the slight constriction beneath the peristome; surface transversely striate; peristome border not revolute; ciliary disc prominent, conical, ciliary circles two; pedicle short, about two-fifths as long as the body. Length of body $\frac{1}{750}$ inch. Habitat.—Pond-water; attached to *Cypris*.

The contracted body is ovate, and the pedicle is then invaginate within the posterior extremity, this margin of the zoöid coming into actual contact with the surface of the object supporting the pedicle.

The characteristic conical form of the ciliary disc, either alone or in connection with the invagination of the pedicle by the contracted body, renders the species readily distinguishable from all other members of the genus.

RHABDOSTYLA VERNALIS, *Stokes*. Pl. VI, figs. 23 and 24.

Rhabdostyla vernalis. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body urceolate, often somewhat gibbous, rather more than twice as long as broad, widest centrally, constricted beneath the peristome border; cuticular surface finely striate transversely; pedicle short, about one-eighth as long as the body; ciliary disc elevated, convex, occasionally developing a central and conspicuous nipple-like projection; ciliary circles two; peristome border slightly everted, not revolute; vestibulum extending to near the body-centre, the vestibular cilia prominent; contractile vesicle near the centre of the anterior body-half; nucleus band-like, curved, located posteriorly; endoplasm granular; contracted zoöid obovate, often nodding, the pedicle invaginate within the posterior body-region. Length $\frac{1}{530}$ inch. Habitat.—Attached to *Cypris* and *Cyclops* in the pools of early spring.

This form closely resembles *Rhabdostyla invaginata* in contour, in the invagination of the pedicle by the contracted body, and in its habitat, but differs conspicuously in the much shorter pedicle, the more posterior position of the pulsating vacuole, and particularly in the form of the ciliary disc, this region in *Rh. invaginata* being markedly conical, while in *Rh. vernalis* it is usually evenly convex. The two species also differ widely in size.

Reproduction of the present species takes place by longitudinal fission, and by encystment. The former method was observed by De Fromentel in an infusorian now relegated to the genus *Rhabdostyla*, but, so far as I know, has not been seen with any other species. Here, however, it takes place rapidly. The body widens until the breadth is nearly equal to the length, and then divides into two longitudinal parts, the moiety which will finally develop an independent pedicle remaining attached to the original foot-stalk by the tip of its posterior extremity until the production of a ciliary girdle, by means of which it becomes temporarily free-swimming. This ciliary ring is developed within a constriction formed around the body at about one-third its length from the posterior extremity, the free-swimming zoöid being a short, pyriform creature with rapid movements. Its free phase, however, is of limited duration, and its subsequent history is essentially that of the natatory zoöid of *Vorticella*.

When reproduction by encystment is about to be accomplished, the body surrounds itself by an ovate, apparently chitinous, cyst, which remains attached to the pedicle. The walls are thick and the surface minutely tuberculate, the anterior extremity being centrally pierced by a circular orifice and surrounded by a short, neck-like projection (figure 24). The cyst is colorless when first formed, but soon becomes brown. The enclosed body gradually shrinks from the walls and becomes ovoid, but the subsequent processes are not known. Although I have obtained these infusoria in abundance, indeed, in the greatest profusion, and have repeatedly witnessed their assumption of the encysted

phase, yet I have never observed subdivision, spore formation, nor any other reproductive method. The encysted animalcules, so far as my observations extend, remain quiescent and unchanged for an indefinite and unknown time. Attempts to preserve them in a life-slide have proved fruitless. Even in this condition of quiescence they appear to need the influence of moving water obtained by the active motions of the *Cypris*, *Cyclops*, or *Canthocamptus* bearing them. The infusorians were obtained from shallow pools as early in the year as the middle of February.

Genus PYXIDIUM, S. K.

PYXIDIUM VERNALE, Stokes. Pl. VI, fig. 25.

Pyxidium vernale. Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Body elongate-vasiform, twice as long as broad, consisting of a subcentral, subspherical region suddenly constricted anteriorly to produce a short, neck-like prolongation, and lengthened posteriorly to form a portion tapering to the pedicle and constituting about one-third of the entire length of the zoöid; peristome border crenulate; ciliary disc large, considerably and obliquely exserted, bearing three ciliary circles; vestibulum extending to near the body-centre; cuticular surface finely striate transversely; pedicle short, slender; contracted body obovate, the subspherical central region then thrown into several annulations over the posteriorly tapering portion. Length of body $\frac{1}{300}$ to $\frac{1}{346}$ inch. Habitat.—Shallow pools with Algae, in early spring. Solitary or few together.

PYXIDIUM URCEOLATUM, Stokes. Pl. VI, fig. 27.

Pyxidium urceolatum. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Body vasiform, less than twice as long as broad, widest centrally, constricted anteriorly, the posterior extremity narrowed to form a short, colorless prolongation somewhat broader than the pedicle; cuticular surface smooth; peristome border truncate; ciliary disc but slightly exserted, ciliary circles two, long and

fine; vestibulum large, extending to near the centre of the body; contractile vesicle in close proximity to the posterior part of the vestibule and apparently emptying into it; pedicle extremely short; the contracted zoöid ovate, posteriorly invaginate. Length of body $\frac{1}{265}$ inch. Habitat.—Pond-water; on rootlets of *Lemna*.

PYXIDIUM INVAGINATUM, *Stokes*. Pl. VI, fig. 26.

Pyxidium invaginatum. Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Body elongate-urceolate, often somewhat gibbous, rather more than twice as long as broad, widest centrally, constricted anteriorly to form a short, neck-like region, and tapering posteriorly to produce a subcylindrical prolongation forming about one-third of the entire length of the zoöid, a transverse cuticular fold usually encircling the body at the origin of the posterior prolongation; pedicle very short, usually only about one-fourteenth as long as the entire body; the cuticular surface finely striate transversely; ciliary disc conspicuous, furnished with two circles of cilia; peristome border truncate, crenulate, not everted, apparently supporting a conspicuous, collar-like membrane; contracted zoöid ovate, frequently nodding, the posterior prolongation always invaginate within the central body-region, and the short pedicle invaginate within the posterior prolongation; vestibulum capacious, extending beyond the centre of the body, its walls ciliate at intervals; endoplasm colorless, transparent; contractile vesicle single, spherical, near the body-centre, and apparently communicating with the vestibulum. Length of the zoöid, including pedicle, $\frac{1}{300}$ inch. Habitat.—Pond-water; attached to the rootlets of *Lemna*.

This very characteristic *Pyxidium* is readily recognizable and easily separable from all previously recorded members of the genus, by the presence of the double posterior invagination so conspicuous in the contracted zoöid. The cuticular striations are so extremely fine that they can be observed with difficulty, except when under the influence of oblique light.

Genus OPISTHOSTYLA, Stokes.

Animalcules resembling those of *Rhabdostyla*, but the rigid pedicle curved near its point of attachment to the submerged object, this part acting, when the zoöid is contracted, like a spring, and throwing the animalcule and the otherwise inflexible foot-stalk backward through the water, the whole immediately becoming upright by the recoil of the curved extremity of the foot-stalk. Inhabiting fresh water.

OPISTHOSTYLA PUSILLA, Stokes. Pl. VII, fig. 1.

Rhabdostyla pusilla. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Opisthostyla pusilla. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Body campanulate, tapering posteriorly, less than twice as long as broad, the surface transversely striate; peristome slightly exceeding the body-centre in width, the border revolute; contracted zoöid ovate; pedicle scarcely longer than the body, the distal extremity shortly and suddenly curved. Length of body $\frac{1}{11\frac{1}{25}}$ inch. Habitat.—Pond-water; attached to *Ceratophyllum*.

This differs from the following species of *Opisthostyla* in the more conical form and less strongly marked transverse furrows of the body, and in the greater proportionate length of the pedicle.

OPISTHOSTYLA ANNULATA, Stokes. Pl. VII, figs. 2 and 3.

Opisthostyla annulata. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124, 1886.

Body conical-campanulate, slightly changeable in form, somewhat gibbous or the lateral margins nearly straight, the zoöid obliquely or vertically placed on the pedicle, less than twice as long as broad, strongly striate or annulate transversely, obovate when contracted; peristome border revolute, ciliary circles two; pedicle as long as the body, the distal extremity suddenly and shortly curved. Body and pedicle each $\frac{1}{11\frac{1}{25}}$ inch long. Habitat.—Pond-water; attached to Algæ.

The short curve at the end of the pedicle at its point of

attachment to the supporting object seems to act as a spring, as already stated, to assist the zoöid in throwing itself backward when the body contracts, the entire infusorian then describing rather more than a semicircle in the water, having the point of attachment of the foot-stalk as the centre. The movement is usually very quickly accomplished, the return of the animalcule to its normally erect position being almost as suddenly achieved.

Genus VORTICELLA, L.

In the *American Naturalist* for August, 1884, the writer described a new member of this genus under the name of *Vorticella Lockwoodii*, one of its characteristics being the presence of two contractile vesicles, whereas in all previously observed species but one had been noticed. A few months later (in the *American Monthly Microscopical Journal* for March, 1885), the writer also published a short communication in reference to the *Vorticellæ* which, up to that time, had been observed to possess two pulsating vacuoles, that list, with additions made necessary by more recent discoveries, being as follows: *V. Lockwoodii*, *V. monilata*, *V. vestita*, *V. rhabdophora*, *V. mollis* and *V. vernalis*. The presence of the double vesicles is not only an interesting and important structural feature, but it is especially worthy of note, since the two have thus far been observed only in those members of the genus which possess some form of cuticular investment, or of surface ornamentation rather than transverse striæ, *V. vestita* being surrounded by a well-marked cellular coating, *V. rhabdophora* having an apparently mucilaginous covering enclosing minute bacilliform bodies, *V. monilata* bearing solid bead-like bosses over its entire surface, *V. Lockwoodii* possessing conspicuously nucleated cuticular elevations, and *V. vernalis* exhibiting a combination of solid hemispherical monilations and transverse striæ. As these species are apparently more highly organized and presumably somewhat higher in the scale than are the smooth or simply striated forms, so are they slightly more complex in structure.

As the species of this attractive group are numerous, some method of easily and rapidly identifying them is often desirable. To accomplish this the writer devised the following Key or Analytical Table, which was originally published in *The Microscope* for May, 1885, and is here reprinted with such changes as time and additional species have made necessary.

A KEY TO THE VORTICELLÆ.

With an amplification of 350 diameters or less,

- A Surface smooth (B).
- A Surface striate or otherwise ornamented (C).
- B Body conical, ovate or elongate (†).
- B Body conical-campanulate or broadly campanulate (††).
- B Body spheroidal (†††).
- C Body conical, elongate or ovate (*).
- C Body broadly campanulate (**).
- † Body three times, or more, as long as wide (§).
- † Body twice, or less than three times, as long as wide (§§).
- † Body once and one-half, or less than twice, as long as wide (§§§).
- †† Width of frontal border exceeding length of body (‡).
- †† Width of frontal border equal to or less than length of body (‡‡).
- ††† Pedicle 6 to 7 times as long as the body (a).
- ††† Pedicle 2 to 3 times as long as the body (b).
- ††† Pedicle about equalling the body in length (s).
- * Body transversely striate only (e).
- * Body apparently longitudinally striate (v).
- * Body posteriorly transversely striate, anteriorly minutely monilated (t).
- * Body not striate, very minutely monilated (u).
- * Body with an external, cuticular investment (f).
- ** With an external *cellular* investment..... *V. vestita* Stokes.
- ** With transverse striæ only (p).
- ** With solid or nucleated bead-like cuticular elevations (r).
- § Conical-campanulate; ciliary disc not elevated; peristome oblique; pedicle 4 to 5 times as long as the body... *V. nebulifera*, Ehr.
- § Conical-elongate; ciliary disc elevated, cushion-like; peristome not oblique. (Pedicel not recorded.) *V. cucullus*, Duj.
- §§ Body conical or conical-campanulate (r).
- §§ Body ovate (r').
- §§§ Campanulate; peristome border undulate, uneven; pedicle thick, less than twice as long as the body..... *V. dubia*, From.

- 222 Conical-campanulate; border not undulate; pedicle 6 to 7 times as long as the body, the sheath apparently twisted.....
V. limnetis, Stokes.
- 222 Ovate; pedicle 3 to 4 times as long as the body, inserted into a depression in the posterior extremity..... *V. fluvialis*, From.
- 222 Ovate; pedicle 3 to 4 times as long as the body; no posterior indentation, but with an annular line around the posterior third. Social *V. alba*, From.
- ¶ Conical-campanulate; pedicle 4 to 5 times as long as the body, enclosing minute, linear, scarlet corpuscles..... *V. picta*, Ehr.
- ¶ Conical; transparent. In stagnant marsh-water. (Insufficiently characterized.)..... *V. gracilis*, Duj.
- ¶ Conical; pedicle 10 to 12 times as long as the body.....
V. longifilum, S. K.
- ¶ Conical; with 2 transverse furrows, behind each of which the body abruptly narrows, and over which it contracts telescopically..... *V. telescopica*, S. K.
- ¶¶ Pedicle decumbent, $\frac{1}{2}$ as long as the body, contracting to $\frac{1}{2}$ a single spiral turn..... *V. brevistyla*, D'Udek.
- ¶¶ Pedicle 3 to 4 times as long as the body. Social *V. alba*, From.
- ¶¶ Pedicle little longer than the body, very thick anteriorly, tapering to its posterior attachment. Social..... *V. crassicaulis*, S. K.
- † Parenchyma densely granular centrally; pedicle thick, 4 to 7 times as long as the body. Social *V. campanula*, Ehr.
- † Parenchyma transparent, pale yellow; tomato or melon-shaped when contracted; pedicle 4 to 5 times as long as the body. Social *V. citrina*, S. K.
- † Parenchyma white; peristome border flattened, expanded, crateriform, often frill-like; pedicle 5 to 8 times as long as the body. Social *V. cratera*, S. K.
- † Parenchyma transparent, colorless; body minute, $\frac{1}{800}$ inch; pedicle stout, 4 times as long as the body..... *V. communis*, From.
- ++ Body conical-campanulate (||).
- ++ Body broadly campanulate (|| ||).
- || Fresh-water. One and one-fourth times as long as wide, apparently having a thick membrane around the junction with the pedicle *V. aperta*, From.
- || Fresh-water. About as long as wide; pedicle 4 times as long as the minute ($\frac{1}{800}$) body *V. communis*, From.
- || Salt-water. Transparent, tapering in straight lines; pedicle 3 to 4 times as long as the body. Social..... *V. patellina*, Mull.
- || || Colorless, or yellowish; oblique or pendulous; posterior extremity conical; pedicle 3 to 4 times as long as the body. Social.....
V. nutans, Mull.

- ||| Hyaline; pedicle decumbent, 3 to 4 times as long as the body....
V. procumbens, From.
- ||| White; posterior extremity narrowly truncate; pedicle short.
V. dilatata, From.
- ||| Green; pedicle 3 to 6 times as long as the body. Social.....
V. fasciculata, Müll.
- a Peristome small, contracted, not everted. Social. On *Cyclops*....
V. globularia, Müll.
- a Peristome broad, not contracted; pedicle long, anterior region
alone contracting, posterior region rigid, the sheath there
thickened. Solitary. Marine. Rare *V. anomala*, G. & R.
- b Peristome with 2 to 3 nipple-like papillae (c).
- b Peristome without nipple-like papillae (d).
- c Peristome narrow, with 3 papillae..... *V. mamillata*, From.
- c Peristome very narrow, with 2 papillae; contracted pedicle
zigzag. *V. constricta*, From.
- d Ciliary disc small, contracted; body $\frac{1}{8}\frac{1}{20}$ in. long... *V. sphaerica*, D'Udek.
- d Ciliary disc very minute; body $\frac{1}{4}\frac{1}{10}$ in. long enclosing refringent
corpscules..... *V. margaritifera*, From.
- e Less than twice as long as broad (g).
- e Twice or more as long as broad (h).
- f Cuticular investment mucilaginous, enclosing scattered, bacilli-
form bodies..... *V. rhabdophora*, Stokes.
- g Peristome narrower than the body-centre (j).
- g Peristome equalling or exceeding the body-centre (k).
- h Peristome narrower than the body-centre (i).
- h Peristome equalling or exceeding the body-centre (m).
- i Body 2 to 3 times as long as wide; peristome about $\frac{2}{3}$ as broad as
the body-centre, with an anterior, nipple-like projection when
contracted; pedicle 3 to 4 times as long as the body.....
V. putrina, Müll.
- i Body twice as long as broad; peristome about $\frac{2}{3}$ as broad as the
body-centre, without nipple-like projection when contracted;
pedicle 3 to 4 times as long as the small ($\frac{1}{5}\frac{1}{10}$ to $\frac{1}{7}\frac{1}{10}$ inch)
body..... *V. utriculus*, Stokes.
- j Fresh-water; peristome $\frac{1}{2}$ as wide as the body-centre; pedicle 2
to 6 times as long as the often subspherical body.....
V. microstoma, Ehr.
- j Fresh-water; peristome more than $\frac{1}{2}$ as wide as the body-centre;
pedicle 2 to 3 times as long as the ovate or pyriform body ...
V. aquae-dulcis, Stokes.
- j Fresh-water; peristome more than $\frac{1}{2}$ as wide as the body-centre;
pedicle from 7 to 8 times as long as the conical-campanulate
body. Attached to tubules of *Conochilus*..... *V. Conochili*, Stokes.

- j Salt-water; peristome $\frac{1}{2}$ as wide as the body-centre; pedicle twice as long as the body..... *V. striata*, Duj.
- j Salt-water; peristome less than $\frac{1}{2}$ as wide as the body-centre; pedicle stout, 4 times as long as the elongate-ovate, annulate body *V. oblonga*, Kirk.
- k Sheath of the pedicle apparently twisted, 7 to 9 times as long as the body; peristome exceeding the body-centre.... *V. octava*, Stokes.
- k Sheath of the pedicle not twisted; parenchyma colorless or whitish (1).
 - 1 Fresh-water; pedicle 10 to 12 times as long as the conical-campanulate body *V. macrocaulis*, Stokes.
 - 1 Fresh-water; pedicle 5 to 6 times as long as the minute ($\frac{1}{13\frac{1}{10}}$ in.) body; peristome equalling the body-centre..... *V. pusilla*, Stokes.
 - 1 Fresh-water; pedicle 2 to 3 times as long as the subpyriform or ovate, small ($\frac{1}{30}$ inch) body; peristome narrower than the body-centre..... *V. Lemnae*, Stokes.
 - 1 Fresh-water; pedicle 2 to 3 times as long as the conical-campanulate ($\frac{1}{3\frac{1}{10}}$ in.) body; peristome exceeding the body-centre.....
V. Floridensis, Stokes.
 - 1 Fresh-water; pedicle not exceeding the small ($\frac{1}{11\frac{1}{25}}$ in.) pyriform or ovate body in length; peristome equalling the body-centre,
V. platysoma, Stokes.
 - 1 Salt-water; pedicle 4 to 5 times as long as the conical-campanulate body..... *V. marina*, Greeff.
- m Pedicle more than 3 times the length of the body (n).
- m Pedicle less than 3 times the length of the body (o).
- n Parenchyma green, densely granular; pedicle 4 to 5 times as long as the large ($\frac{1}{2\frac{1}{10}}$ in.) body *V. chlorostigma*, Ehr.
- n Parenchyma colorless; body 2 to 3 times as long as wide; muscular thread finely granulate. *V. elongata*, From.
- n Parenchyma colorless; muscular thread not granular.
V. parasita, Stokes.
- n Parenchyma whitish or hyaline; pedicle 3 to 6 times as long as the body; stagnant water, and infusions *V. convallaria*, L.
- o Pedicle usually less than twice as long as the obliquely set, colorless body.. *V. hamata*, Ehr.
- o Pedicle stout, 2 to 3 times as long as the colorless, erect, conical ($\frac{1}{5\frac{1}{10}}$ to $\frac{1}{6\frac{1}{10}}$ in.) body; peristome slightly wider than the body-centre *V. macrophyta*, Stokes.
- o Pedicle slender, 2 to 3 times as long as the colorless, erect, conical, small ($\frac{1}{3\frac{1}{25}}$ in.) body; peristome exceeding the body-centre, not revolute. Attached to the gelatinous tubules of *Conochilus volvox*..... *V. conosoma*, Stokes..

- o Pedicle short, or 2 to 3 times as long as the brownish, erect, conical, large ($\frac{1}{150}$ in.) body; peristome much wider than the body-centre *V. spectabilis*, S. K.
- o Pedicle $1\frac{1}{2}$ times as long as the body, which is subcylindrical, $3\frac{1}{2}$ times as long as broad, with 2 anterior and 2 posterior projecting angles *V. quadrangularis*, S. K.
- o Pedicle shorter than the conical body, the latter about 3 times as long as broad, posteriorly invaginate in 2 annulations when contracted.. *V. conica*, Stokes.
- p Colorless; pedicle 5 to 6 times as long as the minute ($\frac{1}{2000}$ in.) body..... *V. microscopica*, From.
- p Colorless; pedicle 5 to 6 times as long as the $\frac{1}{500}$ to $\frac{1}{600}$ in. body; peristome breadth equalling or exceeding the body-length... *V. similis*, Stokes.
- p Colorless; pedicle enclosing brilliant green corpuscles..... *V. appuncta*, From.
- p Green, homogeneous; pedicle 8 to 10 times as long as the $\frac{1}{300}$ to $\frac{1}{350}$ in. body *V. smaragdina*, Stokes.
- r Bead-like cuticular elevations solid; pedicle 4 to 5 times as long as the body *V. monilata*, Tatem.
- r Bead-like cuticular elevations scattered, nucleated.. *V. Lockwoodii*, Stokes.
- s Contracted body spherical or napiform. *V. rhabdostyloides*, Kellicott.
- t Pedicle 6 to 7 times as long as the body; monilations scattered, abundant, minute *V. vernalis*, Stokes.
- u Pedicle 16 to 18 times as long as the body; bead-like cuticular elevations, very minute, scattered..... *V. mollis*, Stokes.
- v Body elongate; length 2 to 3 times the breadth, inflated centrally and posteriorly, constricted anteriorly and posteriorly; pedicle 4 times as long as the body; peristome less than twice the body-centre in width; pond water, New Zealand..... *V. Zealandica*, Kirk.
- v Body conical; length 4 times the breadth; peristome less than twice the body-centre in width. Marine..... *V. plicata*, G. & R.

VORTICELLA NEBULIFERA, Ehr.

VORTICELLA ALBA, From.

Extremely abundant in an old aquarium, March, 1885.

VORTICELLA LIMNETIS, Stokes. Pl. VII, fig. 4.

Vorticella limnetis. Stokes: The Microscope, July, 1885.

Body smooth, conical-campanulate, widest anteriorly, less than twice as long as broad, constricted beneath the peristome, which

exceeds the body-centre in width, is everted and slightly revolute; ciliary disc convex, elevated; endoplasm colorless, granular; pedicle from six to seven times as long as the body, the sheath apparently twisted. Length of body $\frac{1}{425}$ to $\frac{1}{450}$ inch. Habitat.—On *Utricularia*, in the cedar swamps of the New Jersey pine barrens. Solitary.

VORTICELLA CUCULLUS, *From.*

VORTICELLA LONGIFILUM, *S. K.*

VORTICELLA CAMPANULA, *Ehr.*

VORTICELLA CITRINA, *Ehr.*

VORTICELLA NUTANS, *Müll.*

VORTICELLA RHABDOSTYLOIDES, *Kellicott.*

Vorticella rhabdostyloides. Kellicott: Proc. Am. Soc. Micros., 1885.

Body globose, smooth; peristome narrow, the border thickened; nucleus short, stout, slightly curved; pedicle filamentous, not exceeding in length the diameter of the body; contracted animalcule globular, sometimes napiform. Length of body $\frac{1}{900}$ to $\frac{1}{800}$ inch. Habitat.—Attached singly to *Stephanodiscus Niagaræ* and other diatoms, during the winter months, at Buffalo, N. Y.

Prof. Kellicott records that this form is so reluctant to contract that sharp blows on the cover-glass do not always induce the movement, it then exhibiting much the aspect of a species of *Rhabdostyla*. When contracted, however, the pedicle is thrown into more or less of a zig-zag appearance rather than that of the coil common to most species.

VORTICELLA MICROSTOMA, *Ehr.*

VORTICELLA AQUÆ-DULCIS, *Stokes.* Pl. VII, fig. 5.

Vorticella aqua-dulcis. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body ovate or pyriform, very slightly changeable in shape, less than twice as long as broad, slightly constricted beneath the peristome border, the cuticular surface strongly and conspicuously striate transversely; peristome more than one-half the

body-centre in breadth, but not equalling it, the border thickened, not everted; ciliary disc obliquely elevated; pedicle from two to three times as long as the body. Length of body $\frac{1}{750}$ inch. Habitat.—Fresh water; attached to rootlets of *Lemna*. Solitary, or few together. Contracted body obovate.

VORTICELLA PUTRINA, Müll.

VORTICELLA UTRICULUS, Stokes. Pl. VII, fig. 6.

Vorticella utriculus. Stokes: Am. Nat., Jan., 1885.

Body vase-shaped or subpyriform, somewhat changeable in shape, twice as long as broad, widest centrally, tapering posteriorly, and slightly constricted beneath the everted and revolute border of the peristome, whose width is a little less than the greatest breadth of the body; cuticular surface strongly and conspicuously striate transversely; ciliary disc slightly and obliquely elevated; vestibular bristle conspicuous; pedicle from three to four times as long as the body; contracted zoöid obovate or pyriform. Length of body $\frac{1}{625}$ to $\frac{1}{750}$ inch. Habitat.—Attached to *Lemna* rootlets, in ponds, in Western New York. Solitary or scattered.

VORTICELLA MACROPHYA, Stokes. Pl. VII, fig. 7.

Vorticella macrophya. Stokes: Am. Nat., Jan., 1885.

Body elongate-conical or obconic, twice to two and one-half times as long as broad, widest at the anterior margin and thence tapering to the attenuate posterior extremity; peristome border revolute, not everted; cuticular surface finely striate transversely; ciliary disc slightly and obliquely elevated; nucleus band-like, short, curved, and situated in the anterior body-half; pedicle once and one-half to twice as long as the body, the muscular thread stout; contracted zoöid obovate, the posterior extremity sheathing the end of the spirally coiled pedicle. Length of body $\frac{1}{650}$ to $\frac{1}{500}$ inch. Habitat.—Attached to rootlets of *Lemna* from shallow ponds near Olean, Western New York. Solitary.

VORTICELLA MACROCAULIS, *Stokes*. Pl. VII, fig. 8.*Vorticella macrocaulis*. Stokes: Am. Nat., Jan., 1885.

Body elongate-campanulate, one and one-fourth times as long as wide, attenuate and tapering posteriorly; peristome somewhat wider than the greatest width of the body, everted and thickened but not revolute; ciliary disc evenly rounded and elevated; cuticular surface finely striated transversely; contracted body obovate; pedicle ten to twelve times as long as the extended body, its entire length contracting into close coils. Length of body $\frac{1}{600}$ inch. Habitat.—Shallow ponds, attached to *Lemna* and other aquatic plants. Solitary.

VORTICELLA OCTAVA, *Stokes*. Pl. VII, fig. 9.*Vorticella octava*. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body conical-campanulate, somewhat changeable in form, once and one-half to twice as long as broad, tapering posteriorly, slightly constricted beneath the peristome, which is revolute and exceeds the body-centre in width; obovate or pyriform when contracted; cuticular surface finely striate transversely; ciliary disc somewhat and obliquely elevated; pedicle from seven to nine times as long as the body, the hyaline sheath apparently thickened on one margin and twisted about the stout muscular thread; contractile vesicle single. Length of body $\frac{1}{900}$ to $\frac{1}{1000}$ inch. Habitat.—Standing water, attached to *Proserpinaca*. Solitary, or few together.

One border only of the sheath seems to be conspicuously thickened, the spiral line visibly crossing the pedicle and forming a curve on the opposite side, thus producing the twisted aspect. The other margin of the sheath is not distinguishable from the thread when the pedicle is extended, and is apparently then in contact with it.

The body is quite changeable in shape; the usual alteration, besides shortening and widening, is the formation of a deep depression in one side anteriorly, in this habit somewhat resemb-

ling *Vorticella smaragdina*, in which this is usually a conspicuous feature.

As this is the eighth member of the genus found in American waters, and presumably restricted to this continent, the event has been commemorated by compelling the long-stemmed infusorian to bear the ordinal number as its specific title.

VORTICELLA FLORIDENSIS, Stokes. Pl. VII, fig. 10.

Vorticella Floridensis. Stokes: Am. Monthly Micros. Jour., May, 1886.

Body conical-campanulate, changeable in shape, less than twice as long as broad, very finely striate transversely; peristome exceeding the body in width, the border everted but scarcely revolute; ciliary disc elevated; pedicle three or four times as long as the body, the muscular thread stout; endoplasm colorless, finely granular; contracted body subpyriform, the posterior extremity invaginate. Length of body $\frac{1}{300}$ inch. Habitat.—Standing water from the cypress swamps of South Florida.

The change in the form of the body consists chiefly of elongation and compression with irregularly developed lateral depressions.

VORTICELLA PLATYSOMA, Stokes. Pl. VII, fig. 11.

Vorticella platysoma. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body ovate or pyriform, less than twice as long as broad, the anterior body region subspherical, the posterior tapering to the pedicle; cuticular surface transversely striate; peristome equaling the body-centre in width, the border revolute; the ciliary disc not elevated; nucleus band-like, curved, transversely placed in the anterior body-half; pedicle seldom exceeding the body in length. Length of body $\frac{1}{1125}$ inch. Habitat.—Pond-water; attached to Algæ.

VORTICELLA LEMNÆ, Stokes. Pl. VII, fig. 12.

Vorticella Lemnæ. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body conical-campanulate or subpyriform, not changeable in shape, less than twice as long as broad, widest centrally, the

posterior extremity tapering; cuticular surface finely striate transversely; peristome border revolute, not everted, slightly narrower than the body-centre; pedicle from two to three times as long as the body; pharyngeal passage long; contractile vesicle close to the vestibulum. Length of body $\frac{1}{900}$ inch. Habitat.—Pond-water, on the rootlets of *Lemna*. Solitary.

In form this resembles *V. octava*, but is readily recognized as different by its persistence of shape, by the proportionate length of the pedicle, and especially by the absence of the peculiar twisted appearance of the sheath.

VORTICELLA PUSILLA, *Stokes*. Pl. VII, fig. 13.

Vorticella pusilla. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body conical-campanulate, less than twice as long as broad, widest anteriorly, tapering thence to the pedicle; constricted immediately beneath the peristome; cuticular surface transversely striate; peristome equalling the body-centre in width, the border thickened; pedicle from five to six times as long as the body; nucleus apparently ovate, anteriorly placed; contracted body subspherical, invaginating the extremity of the pedicle. Length of extended body $\frac{1}{1300}$ inch. Habitat.—Pond-water; attached to rootlets of *Lemna*. Solitary.

VORTICELLA ELONGATA, *From*.

The form identified with this species corresponded with the type except that the muscular thread was not granulate.

VORTICELLA PARASITA, *Stokes*. Pl. VII, fig. 14.

Vorticella parasita Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body elongate, between two and three times as long as broad, widest centrally, tapering posteriorly to the pedicle; peristome slightly wider than the body-centre, the border thickened, revolute; ciliary disc obliquely elevated, the lowermost or outer series of cilia extending, when in action, almost horizontally;

cuticular surface finely striate transversely; pedicle from three to four times as long as the body; nucleus short, curved, band-like, in the anterior body-half, usually transversely placed; contracted body obovate, the posterior extremity sheathing the pedicle with one or two annulations. Length of body $\frac{1}{640}$ inch. Habitat.—Pond-water; attached singly at intervals, or few together, to the body of an aquatic worm.

VORTICELLA CHLOROSTIGMA, *Ehr.*

VORTICELLA CONVALLARIA, *L.*

VORTICELLA SIMILIS, *Stokes*. Pl. VII, fig. 15.

Vorticella similis. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body broadly campanulate, only slightly longer than wide, very finely striate transversely, soft and somewhat changeable in shape, constricted beneath the peristome border, thence widening and tapering in almost straight lines to the pedicle; peristome equalling or exceeding in width the body-length, the border revolute; ciliary disc slightly and obliquely elevated; pedicle from six to seven times as long as the body; contracted zoöid broadly obovate or subspherical; endoplasm granular. Length of body $\frac{1}{600}$ to $\frac{1}{475}$ inch. Habitat.—Pond-water; social; attached to *Ceratophyllum*.

VORTICELLA HAMATA, *Ehr.*

VORTICELLA CONICA, *Stokes*. Pl. VII, fig. 16.

Vorticella conica. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body elongate-conical, exceeding the pedicle in length, about three times as long as broad, widest beneath the peristome, tapering thence to near the posterior one-fourth, where it is interrupted by a slight, angular elevation, below which it is somewhat narrowed, thence tapering regularly to the pedicle; cuticular surface finely striate transversely, and roughened by minute elevations, so that, under insufficient amplification, the superficies appears to be also longitudinally striate; peristome exceeding the body-centre in width; ciliary disc convex; pedi-

cle stout, shorter than the body; nucleus band-like, long, extending for almost the entire length of one lateral border, and anteriorly curved across the frontal region; contracted body obovate, posteriorly invaginate in two annular folds. Length of body $\frac{1}{260}$ to $\frac{1}{225}$ inch. Habitat.—Standing pond-water; attached to *Cyclops*.

The body of this much-elongated creature resembles in its contour that of *V. quadrangularis*, S. K., and *V. spectabilis*, S. K., but is readily distinguishable from both. In its contracted state it is easily separable from *V. spectabilis*, the latter then being subspherical, and without the posterior annulations of *V. conica*. From *V. quadrangularis* it is separated by the absence of the subcylindrical body, and the anterior and posterior projecting angles of the latter, the small angular elevation encircling the rear part of *V. conica* being unrepresented in the frontal region.

The form here referred to seems much less timid than the majority of the *Vorticellæ*, seldom contracting the body, or throwing the pedicle into the usual spiral coils, as the cover-glass may be repeatedly and somewhat violently disturbed, without in any way altering the expanded animalcule. This might be anticipated by reason of the supporting host's activity, the *Cyclops* leaping through the water by rapid and often long-continued movements, necessarily dragging the *Vorticella* with it. In addition to the six or eight individuals of *V. conica* attached to a single *Cyclops*, the Entomostracan was also loaded with a profusion of *Podophrya fixa* (Müll.) S. K., actively producing and extruding their free-swimming embryos.

VORTICELLA MOLLIS, Stokes.

Vorticella mollis. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body conical-campanulate, somewhat changeable in shape, widest anteriorly, tapering posteriorly, the length scarcely exceeding the width; peristome broad, flattened, crateriform, equalling in width the body-length, the border not revolute;

cuticular surface very minutely tuberculate; contractile vesicle *double*; pedicle from sixteen to eighteen times as long as the body; contracted body subspherical. Length of the extended zoöid, $\frac{1}{600}$ inch. Habitat.—Pond-water; attached to rootlets of *Lemna*. Solitary.

VORTICELLA RHABDOPHORA, *Stokes*. Pl. VII, fig. 17.

Vorticella rhabdophora. Stokes: The Microscope, Feb., 1885.

Body conical-campanulate, changeable in shape, somewhat gibbous and usually obliquely attached to the pedicle, about twice as long as broad, tapering posteriorly, widest at the anterior border, beneath which it is somewhat constricted; cuticular surface finely striate transversely, and also clothed with a delicate, apparently mucilaginous, investment, crowded with short, slightly curved, bacilliform bodies, which, in transverse optic section, present the aspect of minute solid granules; peristome border everted, slightly revolute; nucleus long, band-like, curved, one arm usually extending across the frontal region, and occasionally traversing the ciliary disc; contractile vesicles *two*; pedicle usually less than twice as long as the body; endoplasm colorless, granular. Length of body $\frac{1}{300}$ inch. Habitat.—An infusion of dead leaves.

The delicate mucilaginous coating, in those individuals most abundantly supplied, is usually much deeper than the width of the spaces between the transverse striations, and the curvilinear, bacilliform bodies are densely distributed over the surface, appearing, when the *Vorticella* is seen in optic section, like minute, solid, refractive nodules scattered through this external film. These delicate rods are extremely minute, measuring only $\frac{1}{12000}$ inch in length, demanding a high-power objective for their examination, while the mucilaginous investment is visible under a comparatively low amplification. The bacilliform bodies are usually very abundant, being scattered or arranged in irregularly disposed clusters, formed of several rods lying parallel with each other. Occasionally the film is scanty, the curved rods

then being correspondingly few and scattered, noticeable only at wide intervals on the surface, or along the borders, when the animalcule is seen in optic section. On other individuals the film may be abundantly developed and irregular in thickness.

VORTICELLA VERNALIS, Stokes. Pl. VII, fig. 18.

Vorticella vernalis. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Body elongate-campanulate, less than twice as long as broad, soft and somewhat changeable in shape, widest centrally, thence tapering conically to the pedicle; anterior two-thirds of the cuticular surface densely and irregularly supplied with minute, rounded, solid elevations, the posterior one-third exhibiting distinct transverse striations, with few and very minute cuticular elevations; peristome exceeding the body-centre in width, revolute, its margin and surface minutely monilated; ciliary disc elevated, convex; contractile vesicles *two*, small, usually pulsating alternately; nucleus very long, narrow, band-like; pedicle from six to seven times as long as the body; contracted zoöid subspherical. Length of body $\frac{1}{500}$ inch. Habitat.—Pond-water, in early spring.

This form seems readily distinguishable from all other *Vorticellæ* whose surface is ornamented by cuticular monilations, by the combination of rounded prominences and transverse striations, the latter being chiefly confined to the posterior region. From *V. monilata* it is easily separated by its conical form and the minuteness of the surface beads; from *V. Lockwoodii*, by its shape and the absence of nuclear nodules within the superficial monilations.

VORTICELLA SMARAGDINA, Stokes. Pl. VII, figs. 19 and 20.

Vorticella smaragdina. Stokes: Am. Nat., Jan., 1885.

Extended body, conical-campanulate, changeable in shape, an irregular depression often formed on one lateral border; the width of the peristome nearly equal to the length of the body, the anterior margin dilated, somewhat constricted beneath the

peristome border, the posterior body-half tapering to the pedicle, cuticular surface finely striate transversely and often roughened by minute, scattered granulations; peristome border everted, slightly revolute; ciliary disc very slightly elevated; the entire parenchyma translucent and emerald-green in color; vestibular bristle conspicuous; pedicle colorless, eight to ten times as long as the body, contracting in numerous close coils; contracted body subspherical, a posterior annulation sheathing the extremity of the pedicle. Length of body $\frac{1}{500}$ to $\frac{1}{300}$ inch. Habitat.—Rootlets of *Lemna* and other aquatic plants. Solitary or few together.

VORTICELLA MONILATA, *Tatem.*

VORTICELLA LOCKWOODII, *Stokes.* Pl. VII, figs. 21 and 22.

Vorticella Lockwoodii. Stokes: Am. Nat., Aug., 1884.

Body broadly campanulate, not conspicuously changeable in form, the length about equalling the width, tapering posteriorly to the pedicle, and constricted beneath the border of the peristome, which is everted and equal in breadth to the entire length of the body; subspherical when contracted, and anteriorly crenulated; ciliary disc not elevated; cuticular surface bearing numerous scattered hemispherical or ovate elevations, diverse in size and usually collected about the equatorial region into irregularly disposed series, each prominence enclosing a nuclear nodule; parenchyma finely granular; contractile vesicles *two*, small, spherical, pulsating alternately, one placed somewhat above and in front of the other, near the pharyngeal passage; pedicle four to five times as long as the body. Length of the body and width of the expanded peristome field $\frac{1}{500}$ inch. Habitat.—Pond-water. Solitary or few together.

The characteristics by which this form may be readily distinguished from all *Vorticellæ*, are the existence and structure of the cuticular prominences and the undoubted presence of *two* contractile vesicles.

The cuticular elevations are arranged in a series on the margin of the peristome border, but the nuclear bodies are there

small and frequently obscure or absent. The prominences vary much in size even where most abundant. In contour they are generally hemispherical, but occasionally their outline is ovate, the two forms occurring on the same individual. The shape of the enclosed nucleus is uniformly the same in both, being that of a small circular disc, but that these internal bodies are disciform and not spherical, I have not been able to positively determine. They are, however, probably spherical.

The anterior and posterior regions of the body are, in some individuals, almost naked, while the cuticular prominences are usually more numerous centrally, with a tendency to collect into a more or less conspicuous equatorial zone. Some of the constituents of this belt, with their apparently disc-shaped nuclei, are shown greatly enlarged in figure 22.

It has afforded me much pleasure to dedicate this remarkable member of a remarkable genus to the Rev. Samuel Lockwood, Ph.D., an illustrious naturalist by whose friendship I am honored.

VORTICELLA VESTITA, *Stokes*.

Vorticella vestita. Stokes: Am. Monthly Micros. Jour., Nov., 1883.

Body broadly campanulate, soft and changeable in shape, widest at the anterior border, constricted beneath the peristome, the posterior margin rounded at its junction with the pedicle; cuticular surface clothed by a conspicuously cellular investment; peristome border slightly everted; vestibular bristle conspicuous; pedicle from six to seven times as long as the body, often exhibiting transverse striations when contracted, the muscular thread irregularly roughened by minute granules; contractile vesicles *two*; nucleus long, band-like, curved. Length of body $\frac{1}{500}$ inch. Habitat.—Fresh water. Contracted body subspherical.

The remarkable cuticular investment is formed of a single layer of cells arranged in equatorial series, the upper and lower walls of each constituent cell being nearly or quite parallel, the cells being colorless and usually containing numerous minute

granules exhibiting the Brownian movement. When the infusorian is in a weak or dying condition these cell-contents are so increased in quantity that they become distended and bubble-like, the *Vorticella* then resembling a mass of froth.

Genus *CARCHESIUM*, Ehr.

CARCHESIUM POLYPINUM, (L.) S. K.

CARCHESIUM LACHMANNI, S. K.

Observed by Prof. D. S. Kellicott in the Erie canal and Niagara river, at Buffalo.

CARCHESIUM ASELLI, Eng.

Observed in abundance by Prof. D. S. Kellicott on *Asellus* from the Niagara river in July.

CARCHESIUM GRANULATUM, Kellicott. Pl. VIII, fig. 1.

Carchesium granulatum. Kellicott: The Microscope, vii, 1887.

Bodies elongate-obovate, less than three times as long as broad, slightly constricted beneath the peristome border, widening near the centre, thence gradually tapering to the pedicle; entire cuticular surface ornamented by horizontally disposed, rounded elevations similar to those of *Vorticella monilata*, Tatem; ciliary disc moderately elevated, convex; peristome border thickened, slightly everted; contractile vesicle double, pulsating alternately; nucleus long, somewhat twisted, band-like and longitudinally placed; pedicle dichotomous, not annulate nor septate; colonies composed of few zooids. Length of body $\frac{1}{250}$ inch. Habitat.—Attached to *Cambarus* and aquatic plants near Buffalo, N. Y.

This is the only species of the genus yet observed with more than one contractile vesicle.

Genus *ZOÖTHAMNIUM*, Ehr.

ZOÖTHAMNIUM ARBUSCULA, Ehr.

Observed by Prof. D. S. Kellicott at Buffalo.

ZOÖTHAMNIUM AFFINE, Stein.

Observed by Prof. D. S. Kellicott at Buffalo.

ZOÖTHAMNIUM ADAMSI, Stokes. Pl. VIII, fig. 2.

Zoöthamnium Adamsi. Stokes: Am. Nat., Jan., 1885.

Bodies elongate-conical or conical-campanulate, twice as long as broad, widest anteriorly, tapering to the pedicle, and slightly constricted beneath the peristome border; cuticular surface very finely striate transversely; peristome border wider than the body-centre, revolute; ciliary disk rounded and elevated; contractile vesicle single, situated beneath the peristome border; nucleus short, band-like, curved and anteriorly placed; main rachis of the pedicle usually bifurcate, frequently quadrifid, occasionally tripartite; branches dichotomous, unequal in length commonly shorter than the main stem, the ultimate divisions less than one-half the length of a single zoöid, each division supporting a single animalcule, entire pedicle stout, longitudinally striate; contracted zoöid obovate or subpyriform, the frontal border projecting in snout-like manner, the anterior body-half thrown into prominent longitudinal plications, the posterior body-half into several annulations. Length of body $\frac{1}{400}$ inch; height of main stem $\frac{1}{330}$; of the entire colony $\frac{1}{100}$ inch. Habitat.—Attached to *Cladophora glomerata* on the shore of Luna island, in the rapid water of the Niagara river.

*Genus EPISTYLIS, Ehr.**EPISTYLIS ANASTATICA, (Linn.) S. K.*

Observed by Prof. D. S. Kellicott at Buffalo.

*EPISTYLIS PLICATILIS, Ehr.**EPISTYLIS FLAVICANS, Ehr.**EPISTYLIS TINCTA, Stokes.*

Epistylis tincta. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Bodies conical-campanulate, less than twice as long as broad, soft and flexible, widest anteriorly, the posterior extremity taper-

ing to the pedicle; surface transversely striate; peristome border revolute; ciliary disc not elevated, ciliary circles six or more; the cilia comparatively short; zoöids yellowish in color; pedicle profusely and dichotomously branched, the ultimate divisions nearly three times as long as the bodies; contracted zoöids subpyriform; nucleus band-like, curved, transversely placed in the anterior body-half. Length of body $\frac{1}{166}$ inch; expanded colonies often $\frac{1}{10}$ inch in height, by $\frac{1}{7}$ inch in diameter. Primary pedicle variable in length. Habitat.—Pond-water, in early spring; attached to various submerged objects.

This resembles *E. flavicans* somewhat closely in the form of the zoöids, in their color, in the profusely and dichotomously branching pedicle, but it differs widely in the shape of the contracted bodies, and in the length of the ultimate branches of the foot-stalk. The contracted zoöids of *E. flavicans* are subspherical, in *E. tineta* they are pyriform, and in the latter the ultimate divisions of the pedicle are more than twice as long as the expanded bodies, whereas in *E. flavicans* the bodies are more than twice as long as the final divisions of the foot-stalk. In the present form the pedicle is stout, thick-walled and hollow. In the numerous colonies examined the length of the primary portion has never exceeded twice that of the extended zoöid.

Near the posterior extremity of a majority of the animalcules is a closely packed cluster or layer of problematical bodies, small in size, measuring only about $\frac{1}{5000}$ inch in length by about one-half that in greatest width, and more or less obovate in form. They are refractive and apparently crystalline. The cluster is composed of usually but one layer of these closely approximated little objects, each layer being formed of many of these closely contiguous and seemingly crystalline nodules, the entire collection appearing to be concavo-convex, the convexity being directed posteriorly. The layer is located at about one-fifth the entire length of the extended zoöid from the posterior extremity, extending almost completely across this part of the body, acting apparently as a partition wall between the two

regions, the endoplasm in advance being ordinarily crowded with granular, subspherical food-masses, while posteriorly the body substance is, as a rule, clear, semi-transparent and tinged only by the pale, diffused color of the animalcule. These crystalline bodies, however, are not invariably present. They often occur in young colonies composed of but two zooids, while in other and older zoödendria formed of many animalcules, they may be absent. They may also be apparent in some members of a large colony and invisible in others of the same group.

EPISTYLIS DIGITALIS, *Ehr.*

EPISTYLIS FUGITANS, *Kellicott*. Pl. VIII, fig. 3.

Epistylis fugitans. Kellicott: Proc. Am. Soc. Micros., 1884.

Bodies ovate or subcylindrical, two and one-half times as long as broad, attenuate posteriorly; surface coarsely transversely striate; peristome not exceeding the body-centre in width, the border slightly thickened; ciliary disc narrow, somewhat elevated; primary pedicle short, rarely exceeding in length that of the zooid, often less than half that length; secondary pedicle very short, the zooids sometimes appearing to be sessile on the main stem; colonies consisting of few individuals; contracted body, top-shaped, not plicate or pendulous. Length of body $\frac{1}{400}$ to $\frac{1}{500}$ inch. Habitat.—Attached to *Sida*, in early spring.

The form differs from *E. pyriformis* and *E. tubificis* in being much smaller than either, in its coarsely striate surface, and in its appearance when the body is contracted, not becoming pendulous as in *E. tubificis* or posteriorly plicate as in *E. pyriformis*.

EPISTYLIS CAMBARI, *Kellicott*. Pl. VIII, figs. 4 and 5.

Epistylis cambari. Kellicott: Proc. Am. Soc. Micros., 1885.

Bodies obovate, somewhat gibbous, about once and one-half as long as broad; cuticular surface transversely striate, the striæ under high amplification resolvable into monilations; peristome border thickened, cord-like; ciliary disc conical, about one-half

as wide as the peristome; pedicle stout, more or less curved, often transversely striate, the branches usually secund; colonies composed of numerous individual members; nucleus short, band-like, usually curved, subcentrally and perpendicularly placed; contractile vesicle near the centre of one lateral border; contracted body globular, with a conspicuous, anterior, snout-like projection. Length of body $\frac{1}{500}$ inch. Habitat.—Attached to the gills of *Cambarus* in the Niagara river.

EPISTYLIS NIAGARÆ, *Kellicott*. Pl. VIII, fig. 7.

Epistylis Niagara. Kellicott: Proc. Am. Soc. Micros., 1883.

Bodies elongate-ovate, slightly gibbous, more than three times as long as broad, attenuate posteriorly, constricted beneath the peristome, the cuticular surface smooth; peristome border thickened; ciliary disc convex, obliquely elevated, granular; nucleus band-like, broad, twisted, anteriorly and transversely placed; contractile vesicle anteriorly situated, near the vestibulum; endoplasm granular; pedicle dichotomous, smooth; contracted bodies ovoid, with a conspicuous, snout-like projection. Length of body $\frac{1}{155}$ inch; height of pedicle $\frac{1}{10}$ inch. Habitat.—Attached in great abundance to the antennæ and exoskeleton of cray-fish in the Niagara river. Zoöids composing a colony, numerous.

EPISTYLIS VAGINULA, *Stokes*. Pl. VIII, figs. 11 and 12.

Epistylis vaginula. Stokes: Am. Monthly Micros. Jour., Dec., 1884.

Extended bodies elongate-conical, soft and flexible, twice as long as broad, the peristome widest, beneath which is a slight constriction whence the body gradually tapers to the foot-stalk; cuticular surface finely striate transversely; parenchyma colorless, minutely granular and enclosing small green food particles; peristome border thickened, everted; ciliary disc elevated; nucleus band-shaped, transversely placed in the anterior body-half; contractile vesicle beneath the peristome border; contracted body globose or subpyriform, with a small, snout-like anterior

projection, and usually thrown into several annulations posteriorly, the extremity always sheathing the distal end of the pedicel; foot-stalk dendriform, profusely and dichotomously branching, finely striate longitudinally, irregularly articulate or not, the primary pedicle about twice as long as the branches which are of a nearly uniform length and are closely approximated. Extended bodies $\frac{1}{3\frac{7}{5}}$ to $\frac{1}{3\frac{5}{6}}$ inch long; height of entire colony $\frac{1}{20}$ inch. Habitat.—Pond-water, on *Ceratophyllum*.

The pedicle, in its manner of branching and in the comparative length of the main stem and divisions, resembles that of *Epistylis flavicans* or the beautiful *Dendromonas virgaria*. The conical form of the zoöids, however, and the transverse placing of the nucleus, readily distinguish the species from *E. flavicans*. The posterior annulations of the contracted animalcule are neither characteristic nor constant. They are more or less common with many members of the genus, and, when somewhat modified, are used as a distinctive feature of specific import with *Epistylis plicatilis*; but the peculiar formation of a sheath over the end of the foot-stalk by the extremity of the contracted body is characteristic and of diagnostic value, and it was this little sheath that suggested the specific name.

EPISTYLIS OPHIDIOIDEA, *Kellicott*. Pl. VIII, fig. 8 and 9.

Epistylis ophidioidea. Kellicott: The Microscope, Nov., 1884.

Bodies of two shapes and sizes; one type trumpet-shaped, about twice as long as broad, the frontal border oblique; anterior two-thirds of the cuticular surface finely and obscurely striate transversely, the posterior one-third longitudinally striate; peristome oblique, concave, the border thickened, cord-like; ciliary disc obliquely elevated, concave; contractile vesicle large, located anteriorly; pulsating slowly; nucleus long, linear, curved, extending laterally from the peristomal region through the anterior two-thirds of the body; endoplasm densely granular anteriorly, less so posteriorly. Length of body $\frac{1}{90}$ to $\frac{1}{60}$ inch. Second form reproductive, snake-like in appearance, about ten

times as long as broad; peristome and ciliary disc similar to those of the preceding, but smaller; cuticular surface and endoplasm also similar to those of the preceding zoöids; nucleus long, linear, convolute, situated in the anterior two-thirds of the body, and readily changing its position with the endoplasm; contractile vesicle subcentrally located; bodies often sigmoid or centrally flexed, so that the two extremities approach each other. Length of body $\frac{1}{37}$ to $\frac{1}{40}$ inch. Pedicle long, slender, dichotomously and profusely branched, articulate, the surface longitudinally striate; becoming brown with age, that of the ophidioidean forms capitate. Height of large colonies $\frac{1}{8}$ inch. Habitat.—Creeks of Western New York. Contracted bodies of the trumpet-shaped infusorians pyriform; the contracted ophidioidean zoöids infold the peristome, but only slightly shorten the body.

This very remarkable form is the only known species of the genus exhibiting two kinds of zoöids so widely diverse in contour. If Prof. Kellicott were not so careful and conscientious an observer, the suspicion that the colonies are imperfectly observed members of the polymorphic group of *Zoöthamnium*, might perhaps not be unjustifiable.

Genus OPERCULARIA, *Stein*.

OPERCULARIA HUMILIS, *Kellicott*. Pl. VIII, fig. 14.

Opercularia humilis. Kellicott: The Microscope, vii, Aug., 1887.

Bodies subfusiform, plastic and somewhat gibbous, about twice as long as broad; cuticular surface finely striate transversely; peristome border thickened, slightly everted; ciliary disc narrow, convex, moderately elevated; membranous collar small, inconspicuous; nucleus band-like, curved, transversely placed near the body-centre; pedicle very short, often a mere nodule; colonies composed of from four to eight zoöids; contracted body napiform, with an anterior, snout-like projection. Length of body $\frac{1}{600}$ to $\frac{1}{500}$ inch. Habitat.—Attached to *Gammarus* and various *Entomostraca*, near Buffalo, N. Y.

OPERCULARIA NUTANS, (*Ehr.*) *Stein.*OPERCULARIA STENOSTOMA, *Stein.*

Observed at Buffalo by Prof. D. S. Kellicott.

OPERCULARIA CONSTRICTA, *Kellicott.* Pl. VIII, fig. 15.

Opercularia constricta. Kellicott: Am. Monthly Micros. Jour., July, 1885.

Bodies elongate-subfusiform, about three times as long as broad, soft and changeable in shape, two constrictions or goove-like depressions horizontally encircling the anterior region beneath the peristome; cuticular surface smooth anteriorly, the posterior one-fourth longitudinally striate; ciliary disc elevated, dome-like; ciliary circles two; membranous collar small but conspicuous; vestibulum capacious, extending to near the body-centre, angularly curved near the middle of its course; contractile vesicle anteriorly placed; nucleus not observed; endoplasm granular; contracted body pyriform, the longitudinally striate region then transversely wrinkled; pedicle short, more or less flexuose; zooids few, usually from two to four in number. Length of body $\frac{1}{190}$ inch. Habitat.—Attached to aquatic, case-bearing, lepidopterous larvæ from the Niagara river.

OPERCULARIA ELONGATA, *Kellicott.* Pl. IX, fig. 1.

Opercularia elongata. Kellicott: Proc. Am. Soc. Micros., 1884.

Bodies elongate-subcylindrical, posteriorly somewhat attenuate, from four to five times as long as broad, the anterior border slightly narrowed, truncate; cuticular surface finely striate transversely; ciliary disc conspicuously and obliquely elevated; ciliary circles two; membranous collar conspicuous; contractile vesicle near the posterior termination of the vestibulum; nucleus not observed; contracted body plicate at both extremities, often pendulous; pedicle dichotomous, annulate, the primary portion exceeding the bodies in length, the secondary branches about one-half that length; zooids from four to sixteen in number.

Length of bodies $\frac{1}{200}$ to $\frac{1}{160}$ inch. Habitat.—Pond-water; on aquatic plants near Buffalo.

OPERCULARIA RUGOSA, *Kellicott*. Pl. IX, figs. 2 and 3.

Opercularia rugosa. Kellicott: Proc. Am. Soc. Micros., 1884.

Bodies elongate-subfusiform, about two and one-half times as long as broad, attenuate posteriorly; cuticular surface smooth; peristome border thickened, the margin apparently bevel-edged; ciliary disc narrow, obliquely elevated upon a columnar base which moves piston-like within the peristome; membranous collar inconspicuous; nucleus linear, curved, transversely placed in the anterior body-half; contractile vesicle anteriorly located near one lateral border; endoplasm granular, brownish in color; contracted body obovate, posteriorly transversely plicate, anteriorly produced in a longitudinally plicate, snout-like projection; pedicle stout, corymbosely branched, prismatic, rugose or simply striate, irregularly articulate; branches capitate, the surfaces broad, exhibiting hexagonal depressions, and each supporting as many as forty sessile zooids. Length of body $\frac{1}{160}$ to $\frac{1}{130}$ inch; height of mature colonies $\frac{1}{10}$ inch or greater. Habitat.—Attached to aquatic plants in rather impure water, near Buffalo.

OPERCULARIA PLICATILIS, *Stokes*. Pl. IX, figs. 4, 5 and 6.

Opercularia plicatilis. Stokes: Am. Monthly Micros. Jour., Dec., 1884.

Bodies elongate-ovate, or somewhat conical-vase-shaped, smooth, soft and flexible, the length two and one-half to three times the width; constricted beneath the peristome border, widest in front of the body-centre, tapering and attenuate posteriorly; when contracted broadly ovate-pyriform or subspherical, thrown into transverse folds posteriorly and bearing anteriorly a snout-like, crenulated and longitudinally plicate projection; parenchyma of the body and ciliary disc enclosing numerous green corpuscles, that of the peristome border and posterior one-third of the body usually colorless and finely granular, the cuticu-

lar surface of the latter part finely striate lengthwise; peristome border as wide as the body, somewhat everted, the margin crenulate; ciliary disc considerably and obliquely elevated; ciliary circles two; membranous collar large and conspicuous; pedicle rigid, finely striate longitudinally, dichotomous or umbellate, with three or more branches, and gradually increasing in thickness from the point of attachment to that of division; zoöids attached in sessile clusters of from ten to twenty members; nucleus band-shaped, curved, transversely placed anteriorly; contractile vesicle anteriorly located. Length of extended body $\frac{1}{100}$ inch; height of entire colony $\frac{1}{20}$ to $\frac{1}{10}$ inch. Habitat.—Pond-water; attached to *Ceratophyllum* and *Anacharis*.

The colonies are comparatively so immense in size that they are apparent to the unaided vision. They occur in some profusion on the leaflets of various aquatic plants, the zoöids there forming subspherical clusters about $\frac{1}{35}$ inch in diameter. The foot-stalk, stout, erect and rigid, presents two distinct methods of division: simple furcation into two approximate branches as in figure 4, and a trifid or quadrifid umbellate formation with the branches bifurcated or not, as in the diagram (figure 5.) Which form shall be selected seems to depend upon the vital activity, and consequently the uncomfortably crowded condition of the zoöids.

In figure 4 is shown a small colony with the most usual form of foot-stalk; in figure 5 the comparatively rare umbel-like division, while figure 6 exhibits the characteristic parts of an extended individual. The quadrifid division of the foot-stalk seems very uncommon.

A method of multiplication for the dissemination of the species is by the subdivision of the body into several subglobose or pyriform parts, each bearing a subcentrally located ciliary girdle. At times one of these migrant zoöids attaches itself to the primary foot-stalk of the colony and secretes a long, narrow, individual pedicle, thus complicating the animalcule's somewhat irregularly branching habit.

OPERCULARIA ALLENSI, Stokes. Pl. IX, fig. 7.

Opercularia allensi. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Bodies elongate-fusiform or subvasiform, more than three times as long as broad, widest centrally, tapering posteriorly to the pedicle, constricted beneath the peristome, the cuticular surface very finely striate transversely; peristome border everted, minutely crenulate; ciliary disc very obliquely exserted; ciliary circles two; membranous collar large and conspicuous; nucleus band-like, short, curved, transversely placed in the anterior body-half; contracted zoöid suddenly pendent, obovate, usually with two or more posterior annulations, and always exhibiting at the anterior border a short, but conspicuous snout-like prolongation; pedicle profusely and dichotomously branching, longitudinally striate, annulate irregularly and at wide intervals, the ultimate divisions very short. Length of body $\frac{1}{2\frac{1}{50}}$ inch; height of entire colony $\frac{1}{56}$ inch. Habitat.—Pond-water; attached to Algæ and various aquatic plants.

At first glance this closely resembles *O. nutans* (Ehr.) Stein, great differences being discernible, however, on slight examination. In *O. nutans* the pedicle is strongly and conspicuously annulate; here the annulations are absent or few in number and irregularly placed. The zoöids are here transversely striate, while in *O. nutans* they are presumably smooth. In size the two forms are also widely and distinctly different, the bodies of *O. nutans* measuring only $\frac{1}{4\frac{1}{30}}$ inch in length, while in *O. Allensi* they are almost twice as large; the height of the entire colony of the former is from $\frac{1}{24}$ to $\frac{1}{9}$ inch, an enormous altitude in comparison with the $\frac{1}{56}$ inch of *O. Allensi*. In their contracted state their resemblance is very close.

OPERCULARIA VESTITA, Stokes. Pl. IX, fig. 8.

Opercularia vestita. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Bodies elongate-conical, soft, flexible and somewhat changeable in shape, less than three times as long as broad, tapering

from the region beneath the peristome to the pedicle; cuticular surface, with the exception of the peristome border and ciliary disc, entirely clothed with a coarsely granular, mucilaginous investment; peristome exceeding the body-centre in width, the border slightly revolute; ciliary disc conspicuously exerted, and obliquely elevated; ciliary circles three; vestibular seta conspicuous; contractile vesicle single, spherical, anteriorly placed, apparently within the base of the ciliary disc; nucleus band-like, broad, short and curved; endoplasm granular; contracted body obovate, with several posteriorly developed annulations, and an anterior, snout-like projection; pedicle tree-like, profusely and dichotomously branching, longitudinally striate, becoming chestnut-brown with age; primary pedicle seldom exceeding in height twice the length of a single body, the ultimate branches about one-fifth as long as the zooids, often curved, a single animalcule being stationed on the extremity of each ultimate division. Length of body $\frac{1}{300}$ inch; height of the entire foot-stalk, exclusive of the zooids $\frac{1}{40}$ inch. Habitat.—Pond-water; attached to aquatic plants.

Sub-Family VAGINICOLINA.

Genus VAGINICOLA, *Lamarck*.

VAGINICOLA CRYSTALLINA, *Ehr.*

VAGINICOLA TINCTA, *Ehr.*

VAGINICOLA LEPTOSOMA, *Stokes*. Pl. IX, fig. 9.

Vaginicola leptosoma. *Stokes*: Am. Jour. Sci., xxix, April, 1885.

Lorica subcylindrical, from three and one-half to four times as long as broad, slightly widened centrally, thence rapidly tapering to the narrow, truncate base of attachment, and slightly tapering to the even, subcircular anterior border, the lateral margins of the posterior portion often undulate; enclosed animalcule narrowly elongate-conical, projecting from one-third to one-half of its entire length beyond the lorica aperture, attached posteriorly by means of a short pedicle; cuticular surface transversely striate; nucleus elongate, band-like; contractile

vesicle anteriorly situated. Length of lorica $\frac{1}{150}$ inch. Habitat.—Pond-water; attached to Algæ. Contracted body obovate.

The lorica resembles that of *Vaginicola attenuata* (From.) S. K., but is twice as large, differing further in the proportion borne by the length to the width.

VAGINICOLA AMPULLA, Stokes. Pl. VIII, fig. 13.

Vaginicola ampulla. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Lorica retort-shaped, erect, about three times as long as broad, widest posteriorly, tapering thence to the rounded point of attachment, and anteriorly to the curved neck-like portion; aperture obliquely directed, the margins very slightly everted, the frontal border truncate; enclosed animalcule, when fully extended, projecting for about one-third of its length beyond the lorica. Length of lorica $\frac{1}{125}$ inch. Habitat.—Fresh water; attached to filamentous Algæ.

The lorica is hyaline when young, becoming deep chestnut-brown with age. Very frequently individual lorice are observed with varying proportions of the posterior region colored and semi-opaque, while the frontal portion remained colorless and transparent, others with the entire sheath darkly tinged being almost as numerous. This leads me to suggest that *Vaginicola vestita* (the *Planicola vestita* of De Fromentel), in which the color is described as being restricted to the posterior part of the lorica, may have been diagnosed from an infusorian approaching maturity, and consequently beginning to assume its mature coloration. This seems more plausible than Saville Kent's conjecture that the sheaths may have been repaired, or that the animalcule had occupied an old and deserted lorica on which it had built a new frontal addition.

VAGINICOLA ANNULATA, Stokes. Pl. IX, fig. 10.

Vaginicola annulata. Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Lorica broadly vasiform, somewhat more than twice as long as wide, rounded and inflated posteriorly, the frontal region

slightly narrowed, the anterior border everted and narrowly revolute, the posterior region encircled by a single annular and horizontal inflation; the enclosed animalcule elongate-obconical, the length about four times the width of the peristome, projecting, when extended, for about one-third its length beyond the lorica; peristome abruptly widened, twice as broad as the body, the ciliary disc obliquely elevated; cuticular surface transversely striated; contractile vesicle single, spherical, situated near the anterior border, apparently within the ciliary disc. Length of lorica $\frac{1}{204}$ inch; length of extended zoöid $\frac{1}{150}$ inch. Habitat.—Pond-water.

The posterior annulation encircling the lorica and the very anterior position of the pulsating vacuole readily distinguish this species from the other members of the genus. Two zoöids are frequently to be seen inhabiting the same protective sheath. The latter changes to a transparent brown color with age.

Genus THURICOLA, S. K.

THURICOLA VALVATA, (*Wright*) S. K.

Genus THURICOLOPSIS, *Stokes*.

Animalcules loricate, the loricae as in *Thuricola*, with the addition of an internal, narrow, flexible, valve-rest, adherent to the lorica wall by one extremity, and projecting arcuately across the cavity to receive and support the descended valve; zoöid posteriorly attached to the lorica by a distinctly developed pedicle; otherwise essentially as in *Thuricola*.

THURICOLOPSIS INNIXA, *Stokes*. Pl. IX, fig. 11.

Thuricola innixa. Stokes: Am. Monthly Micros. Jour., Oct., 1882.

Thuricolopsis innixa. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica subcylindrical, sessile, from four to five times as long as broad, somewhat attenuate posteriorly, the base of attachment truncate, the frontal border even, sometimes slightly everted, bearing internally, at some distance from the orifice, a valve-like

appendage, as in *Thuricola valvata*, and an opposite, rigidly attached, but distally flexible membranous, setiform organ projecting arcuately inwards and acting as a support to the descended valve, the wall of the lorica being inflated immediately behind this bristle-like valve-rest; enclosed animalcule pedicellate, projecting, when extended, one-third of its entire length beyond the lorica aperture. Length of lorica $\frac{1}{150}$ inch. Habitat.—Pond-water; attached to various aquatic plants.

THURICOLOPSIS KELLICOTTIANA, *Stokes*. Pl. IX, fig. 12.

Thuricolopsis Kellicottiana. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica subcylindrical, sessile, less than four times as long as broad, the posterior region tapering, attenuate, subcylindrical and forming about one-eighth of the entire length; frontal border slightly everted; posterior extremity truncate; valve and bristle-like support essentially as in *Th. innixa*, the lorica wall not inflated behind the valve-rest; enclosed animalcule, when extended, long and attenuate, about one-fourth of its length projecting beyond the lorica aperture; pedicle filiform, from one-sixth to one-seventh as long as the lorica; cuticular surface smooth; two zooids frequently occupying the same sheath; nucleus extremely long, narrow and undulate; endoplasm granular; contracted body elongate-obovate. Length of lorica $\frac{1}{118}$ inch. Habitat.—Pond-water; attached to various aquatic plants.

This form was first observed by Prof. D. S. Kellicott attached to aquatic plants, at Corunna, Mich. (*Proc. Amer. Soc. Micros*, 1884), and by him referred to as a variety of *Th. innixa*. It occurs sparingly in the writer's locality in New Jersey, and seems sufficiently distinct to merit a specific title and place.

Genus COTHURNIA, *Ehr.*COTHURNIA IMBERBIS, *Ehr.*COTHURNIA VARIABILIS, *Kellicott*. Pl. VIII, figs. 23-26.*Cothurnia variabilis*, Kellicott: Proc. Am. Soc. Micros., 1883.*Cothurnia variabilis* var. *emarginata*, Kellicott: Ib., 1883.

Lorica irregularly ovate, about twice as long as broad, the posterior region rounded, ventricose, compressed, anteriorly produced as a more or less curved, compressed, neck-like prolongation, the dorsal border forming a curve continuous with the general dorsal convexity of the lorica margin, the opposite border anteriorly deeply excavate, the depression rounded; posterior border evenly convex, the anterior orifice subelliptical, horizontal or oblique, the uppermost point, or the continuation of the dorsal lorica convexity, produced as a conspicuous, cusp-like acumination, the centre of each lateral margin often bearing a tooth-like angle, these lateral parts sometimes entirely smooth and even; the anterior border of the posterior ventricose portion of the lorica frequently bearing a spinous projection sometimes apically bilobed, the neck-like region then nearly vertical, and the anterior orifice either oblique and possessing the frontal cusp and even lateral margins, or the aperture nearly horizontal and without the cusp-like acumination, but with a single tooth-like subcentral projection on each lateral border; pedicle short, one-fourth as long as the lorica, or less; loricae usually attached to each other and forming pseudo-colonial groups, after the manner of *Pyxicola socialis*; enclosed animalcule projecting but a short distance beyond the lorica aperture; peristome narrow; endoplasm granular; nucleus band-like, short, curved, perpendicularly and subcentrally placed; contractile vesicle subcentral; loricae becoming yellowish or rust-brown with age. Length of lorica $\frac{1}{3}\frac{1}{4}$ to $\frac{1}{2}\frac{1}{50}$ inch. Habitat.—The branchial appendages of *Cambarus*, where, in early summer, they occur in such profusion as to color the gills brown.

COTHURNIA CANTHOCAMPTI, *Stokes*. Pl. VIII, fig. 10.

Cothurnia Canthocampti. Stokes: Am. Monthly Micros. Jour., May, 1886.

Lorica ovate somewhat gibbous, less than three times as long as broad, widest centrally, the anterior border truncate, not everted, the aperture circular; pedicle straight or slightly curved, transversely plicate, from one-third to one-fifth the length of the lorica; enclosed zoöid transversely striate, attached posteriorly by a short continuation of the external foot-stalk; when expanded, only the peristome border usually extending beyond the lorica. Length of sheath $\frac{1}{300}$ inch. Habitat.—On *Canthocamptus minutus*.

This differs from *C. astaci*, Stein, which it somewhat resembles, in the absence of eversion of the anterior border, the transverse striation of the cuticular surface, and in the very short distance to which the expanded zoöid extends beyond the lorica margin. In size the two are very similar.

COTHURNIA LATA, *Kellicott*. Pl. VIII, figs. 18 and 19.

Cothurnia lata. Kellicott: Proc. Am. Soc. Micros., 1883.

Lorica ovate, compressed, twice as long as broad, dorsal margin convex, the opposite border concave; frontal border oblique, not everted, a slight elevation present near the centre of each lateral edge; posterior margin rounded; pedicle curved, about one-third as long as the sheath. Length of lorica $\frac{1}{300}$ inch. Habitat.—Attached to various Entomostraca in fresh water near Buffalo. Lorica becoming yellowish-brown with age.

COTHURNIA PLECTOSTYLA, *Stokes*. Pl. VIII, fig. 22.

Cothurnia plectostyla. Stokes: Am. Monthly Micros. Jour., July, 1885.

Lorica elongate-urceolate, two and one-half times as long as broad, slightly compressed; inflated, and somewhat gibbous subcentrally, thence tapering posteriorly to the pedicle and anteriorly to a short, subcylindrical neck, the margin truncate, not

everted; pedicle conspicuous, transversely plicate, often sinuose, continued through and filling the tapering posterior extremity of the lorica, and prolonged as a short internal foot-stalk, which is entirely invaginated by the posterior extremity of the contracted animalcule; enclosed zoöid transversely striate, when extended projecting very slightly beyond the orifice of the lorica; nucleus broadly ovate, conspicuous, subcentral. Length of lorica $\frac{1}{250}$ inch. Habitat.—Fresh water, on *Canthocamptus minutus*.

This was very abundant on the Entomostracan mentioned, as were what were supposed to be the immature pedicellate zoöids which were still without a trace of a lorica. The pedicle of these was long, tortuous, and conspicuously plicate, the ovoid bodies also exhibiting transverse striations. The mature forms are readily distinguished from allied species not only by the shape of the lorica and the very short distance to which the body extends beyond the sheath, but chiefly by the peculiar wrinkling of the pedicle and its internal continuation, both the zoöid and the lorica appearing to be pedicellate.

COTHURNIA ANNULATA, *Stokes*. Pl. VIII, fig. 20.

Cothurnia annulata. Stokes: Am. Jour. Sci., xxix, April, 1885.

Lorica ovate, two and one-half times as long as broad, the posterior one-fourth widest and somewhat inflated, yet tapering to the pedicle and often undulate, the posterior margin conspicuously thickened at the point of attachment to the pedicle, the anterior three-fourths tapering to the circular, truncate margin, which is not everted; pedicle short, slightly narrower than the extremity of the lorica, where it is apparently widened and continued through the thickened wall as a longitudinally striate prolongation or foot-stalk to the enclosed zoöid; extended animalcule obconical, protruding but a short distance beyond the lorica, the cuticular surface transversely striate, and bearing near the centre of the body a narrow, transverse, ring-like elevation or ridge. Length of lorica $\frac{1}{450}$ inch. Habitat.—Pond-water; attached to *Myriophyllum*.

The species is readily diagnosed by the presence of the centrally encircling annular elevation, aside from the form of the lorica, which is alone distinctive.

COTHURNIA BIPARTITA, Stokes. Pl. VIII, figs. 16 and 17.

Cothurnia bipartita. Stokes: Am. Monthly Micros. Jour., July, 1885.

Lorica elongate-subcylindrical or elongate-campanulate, gibbous, somewhat curved, one side being longer than the other; two and one-half times as long as broad, widest anteriorly or at the frontal border, tapering posteriorly, finely striate longitudinally, and with irregular transverse markings resembling lines of growth; transparent, colorless when young; margin not everted; aperture variable in form, either elliptical and the borders even, or narrowly ovate and prolonged for some distance down the shorter side of the lorica, the borders then somewhat unevenly curved; lorica divided posteriorly into two unequal parts by a curved, transverse, chitinous partition, to which the enclosed animalcule is sessilely attached; pedicle stout, usually curved, widest at its attachment to the sheath, about one-fifth as long as the lorica; animalcule taking the form of the sheath posteriorly, transversely striate; when extended not reaching to the anterior aperture; peristome narrow, everted, not revolute; ciliary disc small, obliquely elevated; nucleus short, band-like, curved. Length of lorica $\frac{1}{2\frac{1}{5}}$ inch. inch. Habitat.—On *Canthocamptus minutus* from marsh-water, with *Sphagnum*. The longitudinal striations of the lorica are very fine, the irregular transverse lines being much more conspicuous. The former are peculiar to this species, not having been observed in any other member of the genus. They are purposely omitted from the figures. The internal partition, as well as the entire lorica, changes in color with age.

Genus PYXICOLA, S. K.

PYXICOLA PUSILLA, S. K.

Observed by Prof. D. S. Kellicott at Buffalo.

PYXICOLA CONSTRICTA, *Stokes*. Pl. VIII, fig. 21.

Pyxicola constricta. Stokes: Am. Monthly Micros. Jour., Feb., 1884.

Lorica urceolate, two and one-half times as long as broad, slightly curved and gibbously inflated, widest centrally, gradually diminishing anteriorly to the origin of the produced, obliquely set, truncate, neck-like portion, behind which it is somewhat constricted, and posteriorly to the truncate area of insertion of the pedicle, above which, at a distance about equalling the pedicle in height, it is again constricted, thus forming a distinct posterior prolongation; borders of the lorica more or less irregularly undulate; color becoming chestnut-brown with age; pedicle about one-twelfth the height of the lorica, finely striate longitudinally, permanently colorless, but surrounded at its point of attachment to the fulcrum of support by a broad, irregularly outlined annulus, varying in color with the lorica; enclosed animalcule attached to the lorica by means of a stout, short, longitudinally striate foot-stalk; protruding, when expanded, about one-fifth its entire length beyond the lorica; operculum disc-shaped, conspicuous in the older animalcules, changing color with age, completely occluding the orifice of the lorica at the origin of the neck-like prolongation. Length of lorica $\frac{1}{375}$ inch. Habitat.—Fresh water; attached to Algæ.

PYXICOLA ANNULATA, *Leidy*.

Pyxicola annulata. Leidy: Proc. Acad. Nat. Sci. Phila., 1882.

Pyxicola striata. Kellicott: Proc. Am. Soc. Micros., 1884.

Lorica urceolate, slightly curved, two and one-half times as long as broad, inflated subcentrally, tapering posteriorly, the neck-like portion slightly contracted, the aperture oblique, circular; transversely, but variably annulate, often centrally, most frequently at the neck; annulations two or more; becoming chestnut-brown with age; pedicle short; operculum changing in color with the lorica; enclosed animalcule protruding, when extended, about one-fifth its length beyond the lorica. Length

of lorica $\frac{1}{340}$ inch. Habitat.—Fresh water; attached to aquatic plants and other submerged objects.

Genus PLATYCOLA, S. K.

PLATYCOLA DECUMBENS, (Ehr.) S. K.

PLATYCOLA INTERMEDIA, Kellicott. Pl. VIII, fig. 6.

Platycola intermedia. Kellicott: Proc. Am. Soc. Micros., 1884, 1885.

Lorica ovate, depressed, prolonged anteriorly into an obliquely elevated neck-like region, shorter than in *Platycola longicollis*, and not funnel-form, the margin not everted, aperture elliptical; color light brown. Length of lorica $\frac{1}{530}$ to $\frac{1}{240}$ inch. Habitat.—Attached to Confervæ in early spring.

PLATYCOLA STRIATA, From.

Observed by Prof. D. S. Kellicott at Buffalo.

PLATYCOLA CŒLOCHILA, Stokes. Pl. VI, fig. 30.

Platycola cœlochila. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica broadly ovate, becoming brown with age, less than three times as long as broad, dorsal surface convex; posterior extremity rounded, the anterior obliquely rounded or truncate, produced as a very short, vertical, neck-like prolongation, the margins slightly everted, the aperture transversely oval or sub-elliptical, laterally prolonged toward the ventral aspect, presenting, in lateral view, the appearance of a deep, rounded excavation; zoöid, when extended, protruding for a considerable distance beyond the aperture; nucleus long, narrow, band-like. Length of lorica $\frac{1}{215}$ inch. Habitat.—Pond-water; attached to the rootlets of *Lemna*.

Genus LAGENOPHRYS, Stein.

LAGENOPHRYS VAGINICOLA, Stein.

LAGENOPHRYS PATINA, Stokes. Pl. VI, fig. 29.

Lagenophrys patina. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica nearly orbicular, much depressed, upper surface slightly convex, the lower plane; aperture circular, terminating a short,

nearly perpendicular neck-like prolongation, surrounded by a thin, apparently membraneous, horizontally projecting border, its margin irregularly and minutely crenulate. Diameter of lorica $\frac{1}{450}$ to $\frac{1}{500}$ inch. Habitat.—Pond-water; attached to the legs and branchial appendages of *Gammarus*.

In form and size this closely resembles *L. ampulla*, Stein, but differs in the absence of the everted and beaded rim projecting in front of the oral aperture in the first-mentioned species.

LAGENOPHRYS AMPULLA, (Stein) S. K.

Observed by Prof. D. S. Kellicott near Buffalo.

LAGENOPHRYS OBOVATA, Stokes. Pl. IX, fig. 13.

Lagenophrys obovata. Stokes: Am. Monthly Micros. Jour., Aug., 1887.

Lorica obovate, somewhat gibbous, about twice as long as broad, widest centrally, tapering posteriorly, the anterior extremity truncate or slightly concave; aperture valvular, the two lips separating and closing at the extension or retraction of the ensheathed animalcule. Length of lorica $\frac{1}{375}$ inch. Habitat.—Pond-water; attached to *Canthocamptus minutus*. In form and size this most nearly resembles *L. vaginicola*, Stein, but differs from it in the less cordate aspect of the lorica and in the narrower anterior region, the subcentral portion being the widest part of the sheath. The lorica becomes chestnut-brown with age.

LAGENOPHRYS LABIATA, Stokes. Pl. VI, fig. 28.

Lagenophrys labiata. Stokes: Jour. Royal Micros. Soc., Feb., 1887.

Lorica oval, depressed, the lower or adherent surface plane, the superior or dorsal aspect convex, the posterior margin rounded, the anterior bearing a short, anterior-superior, neck-like prolongation formed of two convex, horizontal and valvular lip-like extensions, which open during the protrusion of the ciliary region of the inclosed zoöid, and close at the withdrawal

of that part, the orifice oval, transversely and superiorly directed ; inclosed animalcule frequently filling the entire cavity of the lorica. Length of sheath $\frac{1}{540}$ inch ; width $\frac{1}{750}$ inch. Habitat.—Fresh water ; adherent to the legs and body of *Gammarus* sp.

In figure 28 is shown the outline in profile of the lorica with separated lips.

LAGENOPHRYS NASSA, *Stein.*

Observed near Buffalo by Prof. D. S. Kellicott.

Genus STYLOHEDRA, *Kellicott.*

Lorica erect, posteriorly pedicellate ; otherwise, including the animalcule, as in *Lagenophrys*.

STYLOHEDRA LENTICULA, *Kellicott.* Pl. VII, fig. 23.

Stylohedra lenticula. Kellicott : Proc. Am. Soc. Micros., 1884.

Lorica ovate, compressed, smooth, about twice as long as broad, the posterior extremity rounded, anteriorly slightly truncate ; frontal orifice circular, the valvular processes horizontal, semi-circular, the margins thickened, the lorica region supporting them flexible ; pedicle from one-fourth to one-fifth as long as the lorica, its junction with the latter disciform ; enclosed animalcule nearly filling the cavity of the lorica ; ciliary disc similar to that of *Lagenophrys vaginicola* ; nucleus not observed ; contractile vesicle single, spherical, located in the anterior body-half near one lateral border. Length of lorica $\frac{1}{400}$ inch. Habitat.—Attached to the legs of *Gammarus pulex* from Mud lake, near Owasso, Michigan.

Sub-Family OPHRYDINA.

Genus OPHIONELLA, *S. K.*

OPHIONELLA PICTA, *S. K.*

Observed near Buffalo by Prof. D. S. Kellicott.

Genus OPHRYDIUM, *Ehr.*

OPHRYDIUM VERSATILE, *Müll.*

OPHRYDIUM EICHHORNII, *Ehr.*

OPHRYDIUM SESSILE, *S. K.*

(?) *Ophrydium problematicum*. Herrick: *Science*, iv, July 18th, 1884.

The description, as published by the observer (Mr. C. L. Herrick), is not sufficient to diagnose the species. It is here doubtfully identified with *O. sessile*.

ORDER III HYPOTRICHIA, *Stein.*

Family LITONOTIDÆ, *S. K.*

Genus LITONOTUS, *Wrzes.*

LITONOTUS WRZESNIEWSKII, *S. K.*

LITONOTUS FASCIOLA, (*Ehr.*) *Wrzes.*

Dr. A. S. Parker (*Proc. Acad. Nat. Sci. Phila.*, 1883), has observed a method of reproduction with this form in which the elongated extremity of the infusorian broke up into small masses of protoplasm, which gradually separated from the body, each then exhibiting distinct amœboid movements, the parent, in about two hours, assuming its original shape and activity, although apparently somewhat diminished in bulk. The subsequent history of the amœboid masses was not learned.

LITONOTUS VERMICULARIS, *Stokes*. Pl. IX, fig. 20.

Litonotus vermicularis. *Stokes*: *Ann. and Mag. Nat. Hist.*, Aug., 1887.

Body elongate, flattened, from fifteen to twenty times as long as broad, soft, flexible and elastic, widest centrally, tapering thence to the rounded posterior extremity, and anteriorly to the subapical constriction; the frontal border obliquely rounded; ventral surface longitudinally striate; dorsal aspect ordinarily traversed by a narrow, longitudinally disposed, keel-like ridge; contractile vesicles multiple, thirty or more arranged in a single series near one lateral border, from eight to ten scattered and

disposed near the opposite lateral margin; nucleus moniliform, the nodules ovate, numerous; trichocysts abundant, most conspicuously developed as a dense, radiating series within the frontal border; anal aperture at some distance from the posterior extremity; endoplasm granular. Length of the extended mature body $\frac{1}{60}$ to $\frac{1}{30}$ inch. Habitat.—Standing pond-water.

The largest and mature zoöids are visible to the naked eye as fine white threads gliding through the water.

LITONOTUS VESICULOSUS, Stokes. Pl. IX, fig. 21.

Lotonotus vesiculosus. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body elongate, subfusiform, produced posteriorly into a tapering, pointed, retractile, tail-like prolongation equal to one-fourth the length of the entire zoöid, and extended anteriorly into a narrow, flattened, flexible and extensile neck, about one-half the entire length of the body, its frontal border slightly dilated and widened, and bearing trichocysts at the tip; dorsal region rounded; the ventral flattened, longitudinally striate; nuclei two, spherical, subcentrally located, and apparently without a funiculus; contractile vesicles numerous, small, scattered throughout the cortical layer of the body, and extending in a series through the neck and tail-like prolongations; trichocysts scattered near the body-centre; endoplasm slightly granular. Length of the extended body $\frac{1}{40}$ inch. Habitat.—Pond-water; among *Myriophyllum*.

In form this resembles *L. Wrzesniowskii*, S. K., but is undoubtedly distinct. The relative and proportionate length of tail and extensile neck to each other and to the central body, and the form of the caudal prolongation, are very conspicuously different from the parts in the species dedicated to the Russian naturalist; and the trichocysts, instead of being arranged in a regular row at the border of the neck and obliquely directed, are scattered irregularly in the central part of the body and at the tip of the neck, but not elsewhere. The chief distinguishing characters, however, are the very many minute and irregu-

larly pulsating contractile vesicles, while in the animalcule most resembling this the pulsating vacuole is large, single and posteriorly located. From *L. pleurosigma*, described by the writer, for which it might perhaps be mistaken if observed only in its contracted state, it differs in the greater extensibility of the neck and tail, in the absence of a funiculus, and especially in the arrangement of the contractile vesicles, those of *L. pleurosigma* being disposed in two rows, one on each side of the body near the ventral surface.

Reproduction is by transverse fission, the dividing plane passing between the nuclei, the parts of the latter separating and becoming subspherical with some rapidity, so that before the completion of the reproductive act each infusorial moiety possesses two disconnected nuclei, as did the parent.

LITONOTUS TRICHOCYSTUS, *Stokes*. Pl. IX, fig. 14.

Litonotus trichocystus. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body elongate-lanceolate, flexible and extensile, from six to eight times as long as broad, widest centrally, slightly tapering toward the anterior extremity, which is depressed and somewhat curved toward the right-hand side, but not conspicuously distinguishable from the body proper; tail-like prolongation short, posteriorly rounded; ventral surface longitudinally furrowed; endoplasm usually coarsely granular; nucleus double, the nodules subspherical, subcentrally placed and connected by a funiculus; contractile vesicle single, near the posterior extremity; trichocysts large, numerous, principally confined to the anterior body-half and the posterior extremity, in the former being arranged in an obliquely directed series along the left-hand border, a cluster at the frontal margin, a few on the right-hand border, many scattered irregularly through the central body-region, and an irregular cluster at the extremity of the caudal prolongation. Length of body $\frac{1}{150}$ to $\frac{1}{200}$ inch. Habitat.—Vegetable infusions. Reproduction by transverse fission. Contracted body broadly lanceolate.

LITONOTUS PLEUROSIGMA, Stokes. Pl. IX, figs. 16-18.

Litonotus pleurosigma. Stokes: Am. Monthly Micros. Jour., July, 1884.

Body linear-lanceolate, elongate, flattened, somewhat sigmoid when viewed ventrally, flexible and elastic, length from five to six times the breadth, widest centrally, and tapering to each extremity; dorsal surface convex, the ventral flat, longitudinally striated; neck-like portion equalling about one-fourth the length of the entire body, its extremity curved toward the right-hand side; tail-like posterior extremity short, obtusely pointed, somewhat curved toward the left; oral aperture subterminal, very dilatable; oral cilia not conspicuously larger than the ventral; trichocysts few, long, scattered throughout the body; nuclei two, ovate, subcentral, connected by a funiculus; contractile vesicles small, numerous, the greater number arranged in a line along the left-hand border, three or four dispersed along the right-hand margin; parenchyma of the body coarsely, of the neck and tail-like portions, finely, granular; anal aperture postero-terminal. Length of body $\frac{1}{150}$ to $\frac{1}{100}$ inch. Habitat.—The surface of dead leaves and twigs at the bottom of shallow pools.

In form this animalcule resembles *Litonotus fasciola* (Ehr.) S. K., differing from it in the multiple contractile vesicles. It is somewhat difficult to determine the exact number of these vacuoles. Usually twelve can be counted, nine in a row along the left-hand border and three on the right, but as they come and go in irregular order the observer has quite a task to count and omit none, the infusorian being at the same time in motion.

The position of the oral aperture is also characteristic. In the diagnosis of the genus this orifice is stated to be situated at the base of the neck-like prolongation. With this species, however, the writer has seen large food-masses enter through an opening that is almost apical, and remarkably elastic. On account of this subterminal position it may hereafter be advisable to relegate the infusorian to a new genus.

Conjugation of two individuals has been repeatedly observed. Union takes place between the anterior one-half or two-thirds of the ventro-lateral borders, but how long it continues I have been unable to determine, as none have become united during my observations, all those noticed having joined themselves previous to capture, or being only on the point of separating when first seen. Changes in the nuclei were in each instance sought for, but nothing unusual appeared.

Multiplication is by transverse fission, which, it is presumed, succeeds conjugation. The posteriorly separating moiety possesses the caudal prolongation of the mature zoöid, the freshly-divided surfaces being usually evenly rounded. Within half an hour, however, after complete separation, the neck-like portion is developed on the one, and the tail-like prolongation on the other, so that each infusorian then differs from the mature animalcule in size chiefly, but, at times, in the smaller perceptible number of pulsating vacuoles. Immediately after fission each part bears a remarkable likeness to *Litonotus varsaviensis*, Wrz.

LITONOTUS CARINATUS, Stokes. Pl. IX, fig. 15.

Litonotus carinatus. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body elongate-lanceolate, from five to six times as long as broad, extensile to a subcylindrical or linear form with vermicular movements, the tail-like prolongation short, obtuse; the neck-like portion not distinctly distinguishable from the body, the anterior extremity slightly curved toward the right-hand side, not dilated; entire dorsal aspect longitudinally traversed by a narrow, convex, keel-like elevation; ventral surface longitudinally striate; oral aperture subterminal; nucleus double, subcentrally placed, the nodules ovate, and apparently in contact without a funiculus; contractile vesicle single, near the posterior extremity; trichocysts few, confined to the left-hand border of the anterior body-half; length of body $\frac{1}{300}$ to $\frac{1}{250}$ inch. Habitat.—The bacterial pellicle on the surface of an infusion of dead leaves. Reproduction by transverse fission.

This form was obtained in great abundance on and below the jelly-like layer of bacterial and fungoid growth covering the surface of an infusion of various kinds of leaves. It cannot be easily mistaken for any other species of the genus.

LITONOTUS HELUS, Stokes. Pl. IX, fig. 19.

Litonotus helus. Stokes: Am. Monthly Micros. Jour., July, 1884.

Body elongate-lanceolate, extensile, flexible and contractile, from five to six times as long as broad, widest centrally, thence gradually narrowing to the origin of the anterior neck-like prolongation which is not conspicuously distinguishable from the body, and to the posterior extremity; somewhat gibbous and bearing on the right-hand margin a series of about eight equidistant, hemispherical elevations, each of which contains several trichocysts; dorsal surface smooth and naked, the ventral ciliated and longitudinally furrowed; neck-like prolongation equaling about one-third the length of the entire body, its extremity curved toward the right-hand side; tail-like portion short, flat, obtusely pointed; food particles and endoplasmic granules not scattered throughout the neck, tail or lateral borders of the body; trichocysts very numerous, obliquely set along the left-hand border of the neck and body, continued around the margin of the tail-like region, and contained within the boss-like elevations of the right-hand border; contractile vesicle single, posteriorly placed near the dorsal surface, in advance of the tail-like prolongation, and formed by the coalescence of several small vacuoles; nuclei two, ovate, subcentrally located. Length of extended body, $\frac{1}{150}$ inch. Habitat.—Standing water.

The oral aperture has not been observed. Careful examination has discovered no vacant spot between the multitudinous trichocysts which might be occupied by that orifice.

The infusorian is capable of contraction to about one-third of its extended length, when it presents an irregularly ovate aspect, the right-hand border being coarsely crenated by the approximation of the hemispherical protuberances.

Family CHLAMYDODONTIDÆ, S. K.

Genus CHILODON, Ehr.

CHILODON CUCULLULUS, (Müll.) Ehr.

CHILODON FLUVIATILIS, Stokes. Pl. X, fig. 1.

Chilodon fluvialis. Stokes: Am. Jour. Sci., xxix, April, 1885.

Body irregularly ovate, one and one-half times as long as broad, widest and rounded posteriorly, the left-hand lateral border truncate, the anterior lip-like projection rounded and obscure; ventral surface longitudinally furrowed, the cilia of the frontal border most conspicuous; adoral groove obscure; nucleus large, ovate, subcentral; contractile vesicles numerous, scattered, a single, large, terminal vacuole often developed at the posterior extremity. Length of body $\frac{1}{500}$ inch. Habitat. —Delaware river water.

This differs from other forms in the straight left-hand margin, in the rounded lip, and in its preference for running water. The specimens were taken with Algæ from a rapid stream which forms the waste-weir of the feeder to the Delaware and Raritan canal, and during its passage makes in the hollows of the rocks and among the little heaps of stones, small, comparatively still pools, where this oddly shaped creature was oftenest captured. The infusorian of course hardly lives and thrives in a foaming brook, nor stems the current of the rapids, yet it seems to prefer a locality where the water is not entirely placid, although it will take kindly to quiet surroundings. I have preserved it in a vessel on my table for some weeks.

CHILODON MEGALOTROCHÆ, Stokes. Pl. X, figs. 2 and 3.

Chilodon Megalotrochæ. Stokes: Am. Nat., Nov., 1884.

Body soft, flexible, ovate, the length from once to once and one-half times the breadth, somewhat widest posteriorly; the anterior and posterior extremities rounded, the left-hand border slightly concave near the anterior apex; lip short, obtuse, incon-

spicuously directed toward the left; dorsal surface convex, naked, the ventral one flat, finely striated, the cilia of the anterior extremity somewhat more conspicuous; the adoral groove shallow, directed backward and outward from the pharyngeal orifice, its cilia, under insufficient amplification, presenting the aspect of a single projecting seta; nucleus ovate, granular, mesially placed in the posterior body-half; pharyngeal armature more or less curved; contractile vesicles numerous, scattered. Length of body $\frac{1}{400}$ to $\frac{1}{550}$ inch. Habitat.—Ectoparasitic on the social rotifer *Megalotrocha*.

The infusorian glides rapidly over the surface of the host, often passing from one individual to another, and running to the edge of the ciliary disc, whence a current from a neighboring rotifer occasionally sweeps it into the surrounding water. If carried so far beyond the influence of the currents that it fails to find its way back to the colony, it soon begins to show evidence of uncongenial surroundings. Its form changes, it becomes swollen, pale and ghostly, its cilia act irregularly and the creature speedily dies, the rotifers' cuticular secretions seeming necessary for its welfare. It differs from the cosmopolitan *Chilodon cucullulus* (Müll.) Ehr., in form and size, in the absence of the sharply-pointed anterior extremity or lip, in the greater curvature of the pharynx, in the course of the adoral channel, that of *C. cucullulus* being directed forward and outward from the pharyngeal orifice, and especially in its ectoparasitic habits. The convexity of the dorsal surface varies. In some individuals it is evenly rounded; in others conspicuously flattened and often traversed by irregularly transverse grooves or channels. The curvature of the pharyngeal armature is also variable.

When the parasite is gliding over the host's surface it is not possible to observe the manner of taking food. But individuals having been swept into the water and been brought back by the return current, have occasionally settled on the cover-glass in such a position that the process was apparent. When feeding

from the side of a rotifer or from the retracted and rounded extremity, the anterior end becomes much narrowed and elongated, while the pharynx is protruded and closely applied to the surface which the infusorian infests. Reproduction is by both transverse and longitudinal fission.

CHILODON VORAX, Stokes. Pl. X, fig. 4.

Chilodon vorax. Stokes: The Microscope, vi, June, 1886; Ann. and Mag. Nat. Hist., Aug., 1887.

Body suboval, soft and flexible, twice and a half as long as broad, widest anteriorly, and curved towards the left-hand side, gradually tapering from the sinistral concavity to the rounded posterior extremity, the left-hand border slightly convex, the lip-like projection obtuse or rounded; cuticular surface longitudinally striate; nucleus elongate-ovate or subfusiform, located in the posterior body-half, usually near the right-hand lateral border; contractile vesicles multiple, small, spherical, scattered; an undulating line of cilia extending from the lip, beyond which it frequently projects, to the oral aperture; anal aperture dorsal, near the posterior extremity. Length of body $\frac{1}{125}$ inch. Habitat.—Fresh water, with *Oscillaria* and other Algæ, in early spring.

The rod-fascicle lining the pharyngeal passage is not only somewhat protrusible, as in the other members of the genus, and expansile and contractile at the distal extremity, but it is also freely movable within the body-sarcode around the margin of oral attachment as a centre. The infusorians under observation fed voraciously on certain linear diatoms (probably a species of *Nitzschia*) with which the water teemed, the frustules often being considerably longer than the body of the animalcule in its normal condition, and, after being engulfed, consequently extending through the entire length of the infusorian, and stretching the cuticular surface at both extremities until at these points the limiting membrane became the merest film. Before the process of engulfing was actually witnessed it was an inter-

esting problem as to how the diatom became freed from the posterior region of the pharyngeal passage, which extends almost to the centre of the body. The first supposition was that the posterior extremity was sufficiently protruded under the pressure of the inflexible diatom to allow the latter to pass from the pharynx and then to glide forward, thus partially relieving the posterior pressure. This supposition was not correct. During the passage of the frustule, when the cuticular surface of the rear margin of the body has reached its limit of extension, the pharyngeal tube, containing one end of the long diatom, suddenly and violently rotates forward until its normal position is completely reversed, and the diatom consequently slips out. The act is probably only to a certain extent voluntary, being effectually aided by the strong pressure from the extended cuticular surface, which tends to force the pharyngeal fascicle forward. This pressure is, however, not essential, as the pharyngeal tube is freely movable at the animalcule's will. I have seen it suddenly swing forward to free itself and as quickly swing back into its former and normal position. The latter act is evidently entirely voluntary.* Reproduction is by oblique transverse fission. The animalcule was abundant in its habitat.

CHILODON CAUDATUS, *Stokes*. Pl. X, figs. 5 and 6.

Chilodon caudatus. *Stokes*: *Am. Jour. Sci*, xxix, April, 1885.

Body irregularly obovate, from once and one-half to twice as long as broad, widest anteriorly, the frontal border and the right-hand lateral margin rounded, the posterior extremity of the flat ventral surface tapering to an acute point, the symmetry of the anterior region of the left-hand lateral border interrupted by a sudden narrowing of the body, thus forming a conspicuous, acute, sinistrally projecting lip-like extension; the posterior extremity of the convex dorsal region produced in a short, conical, acuminate, free but immotile, spur-like prolongation; adoral cilia distinct; oral aperture on the right-hand side

* See *The Microscope*, vol. vi, p. 121.

of the median line in the anterior body-half; contractile vesicles numerous, scattered; nucleus subspherical, granular, posteriorly located; anal aperture on the right-hand border near the posterior extremity. Length of body $\frac{1}{600}$ inch. Habitat.—Standing water, with *Azolla Caroliniana*.

In other species a common character of the dorsal region is to become suddenly elevated, and so merged into the general surface as to leave a comparatively flat margin or rim surrounding the lateral and posterior and often the frontal borders; but here, while this plane extension of the body exists laterally and at the rear, it is obscure or obsolete anteriorly, and the postero-terminal border of the dorsum is continued as an acuminate, rigid spur. This extension is not a mere narrowed portion adhering to the flattened region beneath, but a free and disconnected yet inflexible projection. It, with the prominent anterior lip, will render the infusorian easily recognizable. Reproduction is by transverse fission, the projecting lip being formed on the posterior moiety after the complete separation of the zooids.

Genus LOXODES, Ehr.

LOXODES ROSTRUM, Ehr.

Reproduction by transverse, somewhat oblique fission.

LOXODES VORAX, Stokes. Pl. X, fig. 7.

Loxodes vorax. Stokes: Am. Jour. Sci., July, 1884; The Microscope, Jan. 1885.

Body very flexible and elastic, elongate, flattened, from three and one-half to four times as long as broad, anteriorly somewhat curved to the left-hand side and ending in a bead-like apex; posteriorly evenly rounded, somewhat tapering and attenuated; adoral groove wide; pharynx tubular, conical and straight; cilia confined to the ventral surface and distributed throughout the fine longitudinal striations, those at the posterior extremity being somewhat more conspicuous, a row of slightly larger cilia bordering the adoral groove; dorsal surface, under

high amplification, minutely granulate; marginal hispid setae projecting subhorizontally from the left-hand margin, somewhat removed from the right-hand dorso-lateral border and becoming more perpendicular as they approach the anterior extremity; parenchyma pale brownish-yellow, seldom conspicuously vacuolar; contractile vesicle (?) single, in the posterior body-half; nucleus double, subcentral, each part spherical and nucleolated, a funiculus not apparent; numerous small refringent corpuscles scattered throughout the body; anal aperture dorsally located, at a short distance in advance of the posterior extremity. Length of body $\frac{1}{180}$ to $\frac{1}{200}$ inch. Habitat.—Standing water, chiefly among the decaying debris on the bottom.

The whole adoral groove is remarkably flexible and elastic, as indeed is the entire body. The broad furrow can be dilated until it is hood-like or expanded until it is almost a flat surface. Together with the anterior beak, it can be bent until it is in contact with the centre of the ventral region, or near the oral aperture proper. The last is the position when a Monad or other equally small and active food particle is to be engulfed. The beak-like front is flexed, the groove-bearing part dilated and, with the aid of the cilia, formed into a trap from which usually the only escape is down the pharynx. The pharynx itself is short and conical, lacking the curvature so conspicuous in the same part of *L. rostratum*, Ehr.

The sarcode is not noticeably vacuolar, as it is in the Ehrenbergian species. A few scattered lacunae at times appear posteriorly, but the remarkable trabecular aspect common with *L. rostratum* I have not observed. Neither has a contractile vesicle been positively distinguished; a spherical vacuole is quite constantly present in the posterior body-half, but it has not been seen to pulsate.

The nuclei of the type species are described as numerous, scattered throughout the body, and connected together by a funiculus, to which nucleoli are often laterally attached. Such a complicated arrangement I have been unable to detect in *L.*

vorax, even after the use of reagents. Here the nucleus seems to be composed of two separated, nucleolated, spherical nodules, without a connecting funiculus.

The only method of reproduction observed is by obliquely transverse fission.

LOXODES MAGNUS, *Stokes*. Pl. X, fig. 8.

Loxodes magnus. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body, elongate, depressed, seven or eight times as long as broad, very soft, flexible and elastic; narrowest anteriorly, the frontal border rounded and curved towards the left-hand side, the apical extremity terminating in a short, beak-like extension; posterior extremity rounded; lateral margins somewhat convex; ventral surface flattened and longitudinally striate, the dorsal convex; adoral groove occupying about one-seventh of the anterior lateral margin of the ventral surface, the membranous sickle-shaped lining conspicuous, the posterior portion long and narrow; refractive corpuscles numerous, arranged in a single longitudinal series near the right-hand lateral border; nuclei multiple, irregularly distributed; contractile vesicles apparently many and posteriorly located, but not positively identified; endoplasm vacuolar; color brown; cilia and dorsal hispid setæ numerous, short and fine. Length of extended body $\frac{1}{40}$ inch. Habitat.—Standing pond-water. Movements gliding, with frequent twisting and folding of the body.

This is readily distinguishable from the two previously recorded species by its great size and by the number of the marginal refringent corpuscles. The nuclei, or those nodules which I have considered to be the nuclei, are much paler in tint than the corpuscles just referred to, larger, and the centrally placed nucleolus in each is more finely granulate. A funiculus probably exists, although it was not positively observed. The posterior portion of the chitinous pharyngeal membrane often appears to be scarcely more than a brown filament, so narrow is it. Its general course is shown in the figure, but it not rarely

is more or less undulate. This infusorian, like all the members of the genus thus far observed, is essentially a bottom-feeder, gliding over the submerged objects and the residual debris at the lowest parts of the shallow waters which it inhabits.

Family OXYTRICHIDÆ, Ehr.

The adoral cilia of the Hypotricha. Stokes: Am. Monthly Micros. Jour., May, 1887.

Genus KERONA, Ehr.

KERONA POLYPORUM, Ehr.

Genus HEMICYCLIOSTYLA, Stokes.

Animalcules free-swimming, more or less elongate-ovate, soft, flexible and elastic, the extremities rounded; frontal styles twenty or more, arranged in two more or less semicircular rows; adoral ciliary fringe beginning near the centre of the right-hand side of the peristome field; ventral surface entirely clothed with fine setæ arranged in closely approximated longitudinal rows; anal styles absent; contractile vesicle single or double; nucleus multiple.

HEMICYCLIOSTYLA SPHAGNI, Stokes. Pl. X, fig. 9.

Hemicycliostyla Sphagni. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate-ovate, soft, flexible and extensile, four times as long as broad, widest behind the centre; tapering to the rounded posterior extremity and to the convex, narrower frontal extremity which is curved toward the left-hand side; frontal styles about twenty, in two semicircular rows; marginal setæ not differing from the ventral, scarcely projecting beyond the body-margin except at the posterior border; peristome field confined to the anterior third of the ventral surface, the right-hand margin ciliate and bearing a membrane; adoral cilia short; nucleus multiple, the nodules ovate or subspherical, small, numerous and scattered; contractile vesicle double, spherical, placed near the left-hand side of the anterior body-half; anal aperture dorsal,

near the posterior extremity; parenchyma vacuolar; hispid dorsal setæ small. Length of body $\frac{1}{50}$ to $\frac{1}{60}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

HEMICYCLIOSTYLA TRICHOTA, Stokes. Pl. X, fig. 10.

Hemicycliostyla trichota. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate-ovate, somewhat extensile, about three times as long as broad, widest posteriorly, tapering to the anterior extremity, which is slightly curved toward the left-hand side; frontal styles and ventral setæ essentially as in *H. Sphagni*; peristome field confined to the anterior half of the ventral surface, a series of par-oral cilia developed on the left-hand margin, a membrane and a præ-oral ciliary fringe on the right-hand border; nucleus multiple, the nodules small, ovate or subspherical, scattered throughout the entire body; contractile vesicle single, spherical, near the centre of the left-hand side of the peristome field; immotile hispid dorsal setæ very small and fine; parenchyma not vacuolar. Length of body $\frac{1}{60}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

Genus UROSTYLA, Ehr.

UROSTYLA GRANDIS, Ehr.

UROSTYLA GIGAS, Stokes. Pl. X, fig. 11.

Urostyla gigas. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate, extensile, very soft and flexible, when extended five times as long as broad, widest centrally, tapering toward both extremities, the posterior rounded and slightly curved toward the left-hand side, the anterior narrower, rounded and curved toward the right-hand side; frontal styles five or six; ventral setæ clothing the entire lower surface in closely approximated lines; anal styles six, small, slender, fimbriated, not projecting beyond the body; marginal setæ longest and most abundantly developed about the posterior extremity, the right-hand border of which bears two oblique rows of long, arcuate,

vibratile setæ, one series originating on the dorsal surface; peristome field confined to the anterior one-fourth of the ventral surface; the right-hand border ciliate, and an endoral series depending centrally; contractile vesicle single, spherical, on the left-hand side of the peristome field; nucleus multiple; anal aperture opening on the dorsal surface at some distance from the posterior extremity; parenchyma vacuolar; hispid, immotile, dorsal setæ short. Length of extended body $\frac{1}{30}$ inch. Habitat. —Marsh-water, with *Sphagnum*.

UROSTYLA TRICHOGASTER, Stokes. Pl. X, fig. 12.

Urostyla trichogaster. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body elongate, elliptical, soft, and flexible, three times as long as broad, both extremities rounded, somewhat narrowed anteriorly, and slightly curved toward the left-hand side; upper lip prominent, crescentic; the entire cuticular surface roughened by minute elevations in irregularly longitudinal clusters; peristome field obovate or subtriangular, extending obliquely backward from the left-hand side of the frontal border towards the right, to somewhat beyond the anterior third of the ventral surface, bearing on the left-hand margin a fringe of large, strong, adoral cirri and a row of fine par-oral cilia, the right-hand border supporting a conspicuous undulating membrane and a row of præ-oral cilia, a series of long, fine, endoral cilia depending from the median part and continued through the long, narrow, tubular pharynx; the frontal region between the right-hand side of the peristome field and the body-margin beset by numerous uncinatè styles, gradually decreasing in size posteriorly, but suddenly passing into the fine setæ which clothe the entire ventral surface in closely approximated longitudinal lines; marginal setæ uninterrupted, longest on the posterior border; anal styles slender, subequal, ten to twelve in number, arranged in an oblique row, not projecting beyond the body-margin; contractile vesicle single, spherical, on the left-hand side of the peristome near its posterior extremity; nucleus single, subspherical, posteriorly

located; anal aperture subterminal. Length of body $\frac{1}{75}$ to $\frac{1}{100}$ inch. Habitat.—A vegetable infusion. Reproduction by transverse fission.

For some time this was the prevailing form in an infusion, gliding over the fungoid slime on the surface as visible whitish spots. By transmitted light it is brown and semi-opaque.

A nucleus does not seem to be invariably present. Only one has been noticed in any individual, and in many instances none could be perceived even after treatment by reagents and staining-fluids.

The food consists chiefly of the smaller animalcules, the rhizopod *Trinema enchelys*, Leidy, and in several instances of small *Anguillula*, all of which were observed within the endoplasm, while an unsuccessful effort to swallow a large *Anguillula* was noted.

UROSTYLA CAUDATA, *Stokes*. Pl. X, fig. 15.

Urostyla caudata. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate-elliptical, soft, flexible and extensile, five times as long as broad, widest centrally, the anterior extremity rounded and curved toward the left-hand side, the posterior portion narrowed into a straight, broad, tail-like prolongation; frontal styles about twenty; ventral setæ clothing the entire ventral surface in closely approximated longitudinal lines; anal styles eight to ten, long, slender, in an oblique row, usually projecting beyond the body; marginal setæ projecting posteriorly, and developed on the right-hand border of the posterior extremity as a single oblique series of long arcuate setæ; peristome field confined to the anterior third of the lower surface, the left-hand margin finely ciliate in addition to the adoral fringe, the right-hand border bearing a membrane and a præ-oral ciliary series; nucleus multiple, the nodules numerous, scattered; contractile vesicles multiple, arranged in a row along the left-hand body-margin; parenchyma vacuolar; anal aperture opening on the dorsal surface near the posterior extremity. Length of body $\frac{1}{40}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

Genus ONYCHODROMOPSIS, Stokes.

Animalcules free-swimming, soft and flexible; frontal styles six, the anterior three largest and most conspicuous; marginal setæ uninterrupted; ventral styles in four longitudinal rows, the third series from the right-hand body-margin, or the second from the left-hand border, interrupted centrally; anal styles five.

This differs from Stein's *Onychodromus* chiefly on account of the soft, flexible, and uncurassed condition of the body. In the present form there is no trace of a dorsal shield or carapace, the body being quite soft and flexible, and furthermore bearing on the dorsal cuticular surface numerous short hispid setæ. Stein remarks of the form discovered by him and relegated to the genus *Onychodromus*, that the carapace is more indurated than that of *Stylonychia*, and less so than that of *Euplotes*, which is by no means the condition in the present form. The frontal styles, which, however, are of but secondary importance in generic diagnosis, are from sixteen to twenty-eight in number in *Onychodromus*, and the very important ventral setæ from fifteen to twenty-one; in *Onychodromopsis* the former are six in number, and the latter very numerous and arranged in a characteristic manner.

ONYCHODROMOPSIS FLEXILIS, Stokes. Pl. X, fig. 16.

Onychodromopsis flexilis. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body ovate or subelliptical, about three times as long as broad, somewhat narrowed anteriorly and slightly curved towards the left-hand side; marginal setæ longest and largest at the posterior extremity; ventral styles in four longitudinal rows, the second, counting from the left-hand body-margin, centrally interrupted, consisting of two or three anterior and two or three posterior elements; anal styles five, nearly marginal, often furcate or fimbriate, projecting beyond the posterior border; peristome about one-third as long as the body, the inner or right-hand margin bearing a large and, in lateral view, conspicuous membrane;

nucleus double, near the left-hand body-margin, but indifferently in the anterior or posterior body-half; contractile vesicle near the centre of the left-hand margin; dorsal hispid setæ short, inconspicuous, and abundant. Length of body $\frac{1}{200}$ to $\frac{1}{77}$ inch. Habitat.—Standing pond-water, with *Lemnæ*.

Genus HOLOSTICHA, Wrzes.

HOLOSTICHA VERNALIS, Stokes. Pl. X, fig. 17.

Holosticha vernalis Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body subelliptical, about four times as long as broad, very soft and flexible; both extremities rounded, the anterior lip short, crescentic; the peristome extending backward through about one-third of the ventral surface, the right-hand margin ciliate, the adoral series on the posterior half of the left-hand border directed across the peristome field towards the right-hand side, the anterior half directed towards the left hand; frontal styles five or six, scattered, the three anterior largest; ventral setæ forming two median rows, beginning in close proximity to the frontal styles; marginal setæ longest at the posterior border, those on the left-hand side gradually leaving the body-margin and approaching the peristome; anal styles from five to eight, usually fimbriated; contractile vesicle spherical, near the centre of the left-hand side; nucleus not observed; dorsal hispid setæ numerous. Length of body $\frac{1}{140}$ inch. Habitat.—Shallow pools, in early spring, with *Algæ*.

HOLOSTICHA SIMILIS, Stokes. Pl. X, fig. 13.

Holosticha similis. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate-ovate, soft, flexible and somewhat extensile, more than four times as long as broad, the posterior extremity rounded, the anterior narrower, rounded, slightly curved toward the left-hand side; peristome field oblique, confined to the anterior third of the lower surface, narrow, ovate, the right-hand margin ciliate; frontal styles about fourteen; ventral setæ in two straight median rows; anal styles from twelve to fourteen,

slender, in a long oblique row, only the most posterior ones projecting beyond the body; marginal setæ conspicuous, longest, most abundantly developed and projecting at the posterior border; contractile vesicle single, spherical, on the left-hand side of the apical termination of the peristome-field; nucleus moniliform, the nodules ovate or subspherical, in a single or double row, placed near the left-hand body-margin; anal aperture dorsal, near the posterior extremity; dorsal immotile hispid setæ small and fine. Length of body $\frac{1}{130}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

HOLOSTICHA CAUDATA, Stokes. Pl. X, fig, 14.

Holosticha caudata. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate, eight times as long as broad, soft and flexible, widest centrally, constricted near the apical extremity of the peristome field, widened anteriorly, tapering posteriorly in a tail-like prolongation, the tip somewhat dilated and curved toward the right-hand side; anterior border rounded; lip narrow, crescentic; frontal styles three; ventral setæ in two straight median rows, those on the right-hand side largest; anal styles five, slender, the extremities often fimbriated; marginal setæ numerous, large, flattened, projecting and most abundantly developed at the posterior border; peristome field confined to the anterior one-fifth of the ventral surface, the right-hand margin finely ciliate and bearing an undulating membrane; contractile vesicle single, spherical, near the left-hand side of the apical extremity of the peristome; anal aperture dorsal, near the beginning of the tail-like prolongation; immotile dorsal hispid setæ numerous, long and fine. Length of body $\frac{1}{50}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

HOLOSTICHA HYMENOPHORA, Stokes. Pl. XI, fig. 1.

Holosticha hymenophora. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elliptical, from three to four times as long as broad, soft, flexible and somewhat extensile, narrowed anteriorly and slightly

curved toward the left-hand side; lip prominent, crescentic frontal styles five; ventral setæ in two straight, closely approximated median rows; the left-hand series beginning at the apical extremity of the peristome; anal styles five, straight, slender, in an oblique row, the first or right-hand one slightly projecting beyond the body; marginal setæ longest and projecting posteriorly; peristome field extending for one-third the length of the body, the right-hand border nearly straight, finely ciliate and bearing an undulating membrane; contractile vesicle double, near the centre of the left-hand body-margin; nucleus double, ovate; anal aperture subterminal, presumably dorsal; immotile hispid dorsal setæ short. Length of body $\frac{1}{125}$ to $\frac{1}{150}$ inch. Habitat.—Shallow pools, in early spring.

Genus STICHOTRICHA, *Perty*.

STICHOTRICHA SECUNDA, *Perty*.

Stichotricha secunda. Stokes: Jour. Trenton Nat. Hist. Soc., Jan., 1886.

STICHOTRICHA ACULEATA, *Wrzes*.

Genus ESCHANEUSTYLA, *Stokes*.

Animalcules free-swimming, elliptical or ovate, not encircled; frontal styles numerous, more or less uncinatè; ventral setæ in three unequal longitudinal lines; anal styles none; marginal setæ uninterrupted; contractile vesicle canal-like, near the left-hand border. Inhabiting fresh water.

ESCHANEUSTYLA BRACHYTONA, *Stokes*. Pl. XI, fig. 2.

Eschaneustyla brachytona. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate-ovate, soft, flexible and somewhat extensile, from three and one-half to four times as long as broad, both extremities usually rounded, the anterior the narrower, somewhat curved toward the left-hand side, a slight constriction beneath the frontal border; peristome field arcuate, narrow, oblique, confined to the anterior third of the ventral surface, the posterior termination widest, deepest and curved toward the right-

hand side, the right-hand border finely ciliate; frontal styles about twenty-five, in oblique lines, two or three supplementary styles forming the first row; ventral setæ in three unequal series, the right-hand row shortest, the central line longest but not extending to the posterior extremity; no anal styles; marginal setæ uninterrupted, longest and projecting at the posterior border only; contractile vesicle canal-like, extending along the entire left-hand body-margin, interrupted anteriorly by two spherical or subfusiform dilatations, one near the posterior termination of the peristome field, the other near the centre of the lateral body-margin; nucleus not observed; anal aperture postero-terminal. Length of body $\frac{1}{112}$ to $\frac{1}{150}$ inch. Habitat.—Standing water, with dead leaves.

Genus UROLEPTUS, Ehr.

UROLEPTUS LIMNETIS, Stokes. Pl. XI, fig. 3.

Uroleptus limnetis. Stokes: Am. Monthly Micros. Jour., Oct., 1885.

Body elongate, subfusiform, five times as long as broad, widest centrally, tapering posteriorly to a tail-like prolongation forming about one-fifth the length of the entire body; constricted anteriorly into a neck-like portion, less in diameter than that of the body-centre, and about one-fourth the entire body in length; frontal border expanded, rounded, the lip conspicuous, crescentic; peristome field extending to the base of the neck-like constriction, the right-hand margin ciliate; frontal styles three; ventral setæ in two closely approximated median lines, beginning immediately behind the frontal styles and continued through the caudal extremity; marginal setæ projecting, largest and most numerous posteriorly; contractile vesicle single, spherical, on the left-hand side near the apical extremity of the peristome field; nucleus double, ovate; immotile dorsal setæ long and numerous. Length of body $\frac{1}{120}$ inch. Habitat.—Pond-water, with *Lemna*; marsh-water, with *Sphagnum*.

In its extended form this resembles the contracted condition of *Uroleptus longicaudatus*, Stokes, but, aside from the absence

of the prolonged caudal extremity of the latter, differs in the absence also of the undulating peristomal membrane. The anal aperture was not observed. It, however, probably opens on the dorsal surface, as is so frequently the case in members of the Hypotricha.

UROLEPTUS SPHAGNI, *Stokes*. Pl. XI, fig. 4.

Uroleptus Sphagni. Stokes: Ann. and Mag. Nat. Hist., Feb., 1886.

Body clavate or broadly obovate, depressed, three times as long as broad, extensile posteriorly; widest and rounded anteriorly, and somewhat curved towards the left-hand side, thence tapering to an attenuate, usually pointed, caudal prolongation, which, when extended, equals or exceeds in length the greatest width of the body; lip crescentic, prominent; anterior border somewhat curved towards the dorsal aspect, thus forming a conspicuous transverse groove or depression on the frontal region of the dorsum; peristome field broad, extending through the anterior one-third of the ventral surface, its posterior termination curved toward the right-hand side, the left-hand margin bearing the adoral and a series of fine par-oral cilia, the right-hand border finely ciliated and supporting an undulating membrane; frontal styles four or five; ventral setæ in two median lines, extending into the caudal prolongation; marginal setæ projecting posteriorly, those on the left-hand side originating at the posterior extremity of the peristome field in close proximity to the ventral setæ, and extending obliquely and longitudinally towards the posterior portion of the left-hand border; contractile vesicle single, spherical, on the left-hand side of the peristome termination, near the body-margin; nucleus double, elongate-ovate, with a laterally attached nucleolus; dorsal hispid setæ numerous, fine and short; anal aperture on the left-hand border of the dorsal surface near the origin of the caudal prolongation. Length of body $\frac{1}{100}$ inch. Habitat.—Standing water, with *Sphagnum*.

The caudal prolongation is very frequently extended until it

becomes almost filiform. It is then also often arcuately curved. In the numerous specimens examined I have been able to determine the existences of but one nucleolus, which is attached to the anterior nuclear nodule. Even the use of reagents failed to disclose a second.

UROLEPTUS LONGICAUDATUS, *Stokes*. Pl. XI, fig. 5.

Uroleptus longicaudatus. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body narrowly subfusiform, elongate, about eight times as long as broad, extensile, widest centrally, tapering posteriorly to a long, narrow, attenuate tail-like prolongation forming one-third the length of the entire body; anteriorly constricted into a neck-like portion, the frontal region expanded and rounded; lip narrowly crescentic; frontal styles three; marginal setæ large, flattened, projecting, longest and most abundantly developed about the caudal prolongation and posterior extremity; ventral setæ in two closely approximated median rows, one only continued through the caudal prolongation; peristome field confined to the anterior fifth of the lower surface, the right-hand border bearing a narrow membrane; contractile vesicle single, spherical, near the left-hand border of the neck-like constriction; nucleus double, ovate; anal aperture dorsal, near the beginning of the tail-like prolongation; hispid dorsal setæ forming several longitudinal rows. Length of extended body $\frac{1}{120}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

UROLEPTUS DISPAR, *Stokes*. Pl. XI, figs. 6 and 7.

Uroleptus dispar. Stokes: Proc. Am. Philos. Soc., Jan., 1886.

Body elongate-oblongate, elastic, four to five times as long as broad, widest centrally, tapering posteriorly and terminating in a narrow, flattened, tail-like prolongation; anterior region depressed; frontal border rounded, the ventral surface prolonged anteriorly as a short, projecting crescentic lip; peristome field extending for about one-third the entire length of the body, the

right-hand border ciliate and apparently having a narrow, band-like, undulating membrane; ventral setæ in two median lines, continued to the termination of the caudal prolongation, those of the right-hand series largest and most numerous; marginal setæ large, projecting beyond the body-margin anteriorly on the right-hand side, and about the caudal extremity, where they are longest and most abundantly developed, those of the right-hand body-margin largest and conspicuously flattened; frontal styles three; contractile vesicle single, spherical, near the centre of the left-hand border; nucleus double, ovate; dorsal aspect bearing a median and an uninterrupted marginal series of immotile hispid setæ; anal aperture opening on the dorsal surface near the beginning of the caudal prolongation. Length of body $\frac{1}{180}$ to $\frac{1}{150}$ inch. Habitat.—Fresh water.

Genus PLATYTRICHOTUS, *Stokes*.

Animalcules free-swimming, soft and flexible, more or less depressed, flask-shaped, widest and inflated posteriorly, narrowest and depressed anteriorly, the ventral surface flattened; frontal styles five, uncinatæ; ventral setæ in two straight median lines; anal styles none; marginal setæ broad, flat, uninterrupted; nucleus single; contractile vesicle single, near the centre of the left-hand border. Inhabiting fresh water.

PLATYTRICHOTUS OPISTHOBOLUS, *Stokes*. Pl. XI, figs. 8 and 9.

Platytrichotus opisthobolus. Stokes: Proc. Am. Philos. Soc., 121, 1886.

Body flask-shaped, depressed, less than three times as long as broad; frontal margin rounded, lip narrow, crescentic; posterior extremity soft and changeable in shape, obtusely pointed, emarginate or bifid, but usually evenly rounded; frontal styles five; ventral setæ in two median rows, increasing in length posteriorly, those of the right-hand series largest and most numerous; marginal setæ large, lamelliform, obliquely truncate, projecting beyond the right-hand body-margin, the posterior ones continued

across the posterior part of the dorsal aspect; peristome field extending to the centre of the ventral surface, the left-hand margin with a series of fine par-oral cilia, the right-hand border ciliate and bearing a membrane; contractile vesicle single, spherical, near the centre of the left-hand border; nucleus single, large, ovate, in the posterior body-half; anal aperture postero-terminal; dorsal surface bearing numerous long hispid hairs in longitudinal lines and three large vibratile setæ developed anteriorly. Length of body $\frac{1}{145}$ inch. Habitat.—Marsh-water, with *Sphagnum*.

This posterior extremity is changeable in form. When first observed the part may be conspicuously bifid, soon to give place to an obtusely pointed, a truncate or an evenly rounded tip, or, as seen in a single instance and illustrated in figure 9, one point of the bifurcation may be extended in a way to suggest a pseudopodium, with a bulbous termination, the whole to be finally withdrawn into a rounded, emarginate or otherwise modified border. Consequently the infusorian has the ability, by the extrusion of a caudal prolongation, to come very close to a *Uroleptus*, and by the withdrawal of the tail to return to its proper generic position.

The lamelliform marginal setæ, as they approach the posterior extremity, gradually leave the ventro-lateral border and are developed on the dorsal surface in a single row passing about the posterior part at a short distance from the margin. The utility of this arrangement it is difficult to imagine, unless it is to accommodate the anal aperture.

The large adoral cilia somewhat abruptly change their position in relation to the peristome field as they approach the centre of the left-hand border, the free extremities of those most anterior being directed toward the body-margin, while the tips of the posterior ones are vibrated above the peristome field, the alteration at the point of transition being quite sudden. I have long suspected that this might be the arrangement in other peristomal infusoria, but have not been previously able to demonstrate it.

In its movements the creature is erratic. Remaining for a time quietly lying with the ventral aspect upwards, suddenly, with a lunge like that of a microscopic cetacean, it rolls over, and exposes the dorsal surface, only to almost immediately begin a series of wild and grotesque backward tumblings, varying these acrobatic performances by rapid backward swimming, occasionally throwing a backward somersault. It was the broad marginal setæ and these curious movements that suggested the name as the flat-haired animalcule that tumbles over backward.

Genus OPISTHOTRICA, S. K.

OPISTHOTRICA EMARGINATA, Stokes. Pl. XI, fig. 10.

Opisthotricha emarginata. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body elongate, obovate, soft and flexible, depressed, about four times as long as broad, widest anteriorly, the frontal border rounded; somewhat tapering to the posterior extremity, the right-hand margin of which is conspicuously emarginate; peristome field arcuate, narrow, without an inner or right-hand border, extending from the frontal margin for about one-third the length of the body; eight frontal styles, six scattered setose ventral, and five large, conspicuous anal ones; marginal setæ scarcely interrupted at the posterior extremity, more numerous on the right-hand border; caudal setæ three; several longitudinal rows of hispid setæ on the dorsal surface; nucleus double, ovate; contractile vesicle single, spherical, close to the left-hand border, near the posterior termination of the peristome. Length $\frac{1}{200}$ to $\frac{1}{175}$ inch. Habitat.—Standing water, with aquatic plants. Reproduction by transverse fission.

In its movements, this infusorian is rapid and erratic. Frequently, after remaining comparatively quiescent, it suddenly darts backward entirely out of the field of the objective.

The contractile vesicle expels its contents through the dorsal aspect at complete systole, forming there a conspicuously projecting elevation of the cuticular surface.

*Genus OXYTRICHA, Ehr.**OXYTRICHA HYMENOSTOMA, Stokes. Pl. XI, fig. 12.*

Oxytricha hymenostoma. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body subelliptical, soft and flexible, about twice and a half as long as broad, both extremities rounded, the left-hand region of the frontal border somewhat oblique, the left-hand body-margin slightly concave anteriorly; lip short, crescentic; frontal styles five uncinat and three setose; ventral styles five, two near the apex of the peristome field, one central, two near the anal styles; the latter five in number, the three on the right-hand side usually projecting beyond the body; marginal setæ continuous, larger and longer on the posterior border; peristome extending to the centre of the ventral surface, the right-hand margin ciliated and bearing apparently two membranes of unequal width, the left-hand border furnished with a series of very fine par-oral cilia; nuclei two, ovate; contractile vesicle spherical, near the centre of the left-hand border. Length of body $\frac{1}{300}$ to $\frac{1}{250}$ inch. Habitat.—Hay-infusion. Movements rapid.

The appearance of two peristomal membranes is very distinct, and has been observed in all the numerous individuals examined. Their presence is unique, so far as the *Oxytrichæ* are concerned, and my impression is that such an addition to the not uncommon single membrane has not been previously recorded with any other member of the Hypotricha.

*OXYTRICHA PLATYSTOMA, Ehr.**OXYTRICHA ACUMINATA, Stokes. Pl. XI, fig. 14.*

Oxytricha acuminata. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body elongate-lanceolate, soft, flexible, and posteriorly somewhat extensile, about six times as long as broad when extended, the frontal border rounded and projecting as a soft, flexible, prominent lower lip; posterior extremity pointed, tapering; frontal styles eight or ten; ventral uncini five, three anteriorly

placed, two near the five anal styles, the latter scarcely projecting beyond the lateral borders, remote from the posterior extremity; marginal setæ uninterrupted, projecting beyond the body posteriorly only; peristome field extending through about one-fifth the ventral surface, the right-hand border ciliated and bearing an undulating membrane; contractile vesicle occasionally double, one situated near the centre of the left-hand body-margin, the other smaller and placed near the apical extremity of the peristome field; nuclei multiple (usually four), the nodules ovate, each commonly with an externally attached nucleolus; dorsal hispid setæ long, arranged in about six longitudinal series; endoplasm granular. Length of body $\frac{1}{225}$ to $\frac{1}{150}$ inch. Habitat.—Pond-water, with Algæ. Movements rapid and erratic.

OXYTRICHA CAUDATA, *Stokes*. Pl. XI, fig. 11.

Oxytricha caudata. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body elongate-ovate, soft and flexible, five or six times as long as broad, the anterior border obliquely rounded and slightly curved toward the left-hand side, posteriorly tapering to the conspicuous, attenuate, pointed, and somewhat retractile tail-like extremity; peristome from one-fifth to one-sixth as long as the body, the right-hand margin bearing an undulating membrane; the seven or eight adoral cilia bordering the anterior extremity large and setose, radiating when quiescent; frontal styles five, uncinatæ, with three smaller supplementary setæ; ventral styles five, three anteriorly and two posteriorly placed; caudal styles five, remote from the posterior extremity; marginal setæ uninterrupted, occasionally fimbriated, projecting posteriorly only; nuclei two, ovate, near the left-hand body-margin; the single spherical contractile vesicle situated between the nodules, in close proximity with the left-hand body-margin; hispid setæ forming several longitudinal dorsal rows, prominently projecting laterally. Length of body $\frac{1}{100}$ to $\frac{1}{120}$ inch. Habitat.—Standing pond-water, with *Lemna*.

The large, almost uncinate, adoral cilia bordering the frontal region are, when the animalcule is quiescent, to all appearance rigidly extended. They then bear a resemblance to the same appendages so abnormally developed in *Actinotricha*. This infusorian's movements are rapid, with frequent rather prolonged intervals of rest. So far as I am aware there is no other species of the genus with the attenuate and somewhat retractile tail-like extremity. The species is readily recognizable by these characteristics alone.

OXYTRICHA BIFARIA, *Stokes*. Pl. XI, fig. 13.

Oxytricha bifaria. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body oval, less than three times as long as broad, the right-hand lateral border convex, the left-hand margin flattened, the anterior extremity bearing a prominent, crescentic, lip-like projection, the posterior extremity obtusely pointed, its left-hand margin obliquely rounded; ventral styles five, scattered, the posterior one in close proximity to the anal styles, the latter five in number, forming two distinct and completely separated groups, the most posterior of which is composed of two large styles projecting beyond the body-margin, the anterior cluster being formed of three smaller elements placed above and to the left-hand side of the posterior group, and not extending beyond the margin of the body; peristome reaching to the centre of the ventral surface, the right-hand border ciliate and bearing a narrow membrane, a linear series of endoral cilia depending from the central region of the peristome field; marginal setæ uninterrupted, longest and largest on the posterior extremity; nucleus double, the nodules large, ovate; dorsal hispid setæ short and inconspicuous. Length of body $\frac{1}{100}$ inch. Habitat.—An infusion of hay. Endoplasm granular, brownish and semi-opaque. Movements rapid and erratic.

This infusorian is quite variable in contour, being often evenly oval or elliptical, while other individuals appear with the frontal region somewhat curved towards the left-hand side.

The essential characters, however, are constant, and by them the animalcule can readily be recognized as distinct from previously recorded members of the genus, the peculiar and distinguishing arrangement of the anal styles making it easily separable from other *Oxytrichæ*.

The most posterior of the five ventral styles is so intimately connected with the anterior group of anal uncini that careful scrutiny is usually needed to positively observe it. Its functions, however, its habit of curving forward, and its flexibility readily distinguish it from the anal cluster. The elements of the latter are rigid and unbending, only the one on the extreme right usually having great freedom of movement. The extremities of the two forming the posterior group are often fimbriated.

With this, as with *Oxytricha hymenostoma*, there is some appearance of a double peristomal membrane; but it is not conspicuous nor even very distinct.

Genus TACHYSOMA, Stokes.

Animalcules free-swimming, soft, and flexible; frontal styles from eight to ten, the three anterior usually the largest; ventral styles five, scattered; marginal setæ at some distance from the lateral borders, interrupted on the posterior margin; anal styles five; caudal setæ none; dorsal hispid setæ usually numerous and conspicuous.

TACHYSOMA PARVISTYLA, Stokes. Pl. XI, fig. 16.

Tachysoma parvistylum. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body elongate-ovate, less than three times as long as broad, widest posteriorly, narrowed anteriorly, to form a neck-like region composing about one-third the length of the entire body, the frontal lip small; locomotive styles small and short, the frontal ten in number, the anterior three largest; ventral styles five, the posterior two in close proximity to the anal, the three anterior arranged in a single longitudinal series; anal styles

five, usually very flexible and active; marginal setæ scarcely projecting except posteriorly; right-hand margin of the peristome field sigmoid; contractile vesicle spherical, near the centre of the left-hand body-margin; dorsal hispid setæ small and inconspicuous. Length of body $\frac{1}{400}$ inch. Habitat.—Shallow pools, in early spring. Movements active.

This agile, colorless form is notable for its small styles; they are the most minute that I remember to have observed on any member of the Hypotricha.

TACHYSOMA AGILIS, Stokes. Pl. XI, fig. 17.

Tachysoma agile. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body elongate-oval, about four times as long as broad, both extremities evenly rounded; peristome field arcuate, extending through about one-fourth of the ventral surface, without a right-hand or reflected inner border; marginal setæ in close proximity to the five scattered ventral styles; anal styles five, large, often finely fimbriated, and with a tendency to form two groups, the two elements on the right-hand side usually extending obliquely towards the right; contractile vesicle near the centre of the left-hand body-margin, gibbously extending the region at complete diastole; nucleus double, each ovate nodule with an external sub-spherical nucleolus; dorsal hispid setæ long, fine, clothing the dorsal surface in several longitudinal rows. Length of body $\frac{1}{375}$ inch. Habitat.—Pond-water.

I was at first disposed to identify this with *Pleurotricha echinata* (C. & L.), S. K.; but that form, as suggested by Kent, probably belongs to another genus, being relegated to Stein's *Pleurotricha* with some doubt, as the supplementary marginal setæ referred to are evidently luxuriantly developed dorsal hispid setæ. The absence of all trace of a supplementary ventral series of styles, together with the softness and flexibility of the body, exclude it from *Pleurotricha*, while the latter qualities and the absence of caudal setæ exclude it from *Stylonychia*, which

it otherwise somewhat closely resembles; and, finally, the interruption of the marginal setæ at the posterior border refuses it admission among the species of *Oxytricha*, and from *Histrio* it is further excluded not only by the posterior interruption of the marginal setæ, but by its soft and elastic body.

TACHYSOMA MIRABILIS, Stokes. Pl. XI, fig. 15.

Tachysoma mirabile. Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body elliptical, less than four times as long as broad, the extremities equally rounded; frontal, ventral, and marginal styles essentially as in *T. agilis*, but smaller and more setose; anal styles five, without tendency to form two groups; peristome field arcuate, extending through about one-fourth the length of the ventral surface, reflected or right-hand inner border none; contractile vesicle spherical, near the centre of the left-hand body-margin; nucleus single, elongate, subcentrally located, with an elongate, laterally attached nucleolus; endoplasm granular; dorsal hispid setæ long, most conspicuously developed near the posterior extremity. Length $\frac{1}{450}$ inch. Habitat.—Standing pond-water.

This form bears a close resemblance to the preceding member of the genus, differing from it somewhat in size, but most conspicuously in the remarkable nucleus and nucleolus. The latter is so large and so closely resembles the nucleus that the two might be considered a uniquely arranged double nucleus, especially in certain individuals in which the nucleolus has become slightly separated from its lateral attachment. In none of the Hypotrichous Infusoria, so far as I am aware, has a similar nucleus been previously observed.

The movements of the animalcule are rapid and erratic. The body is frequently observed to be laterally curved, which region then becoming somewhat concave, the two extremities thus remotely approaching each other. The infusorian when in this condition often swims by rotation on the longitudinal axis.

*Genus HISTRIO, Sterki.***HISTRIO COMPLANATUS, Stokes. Pl. XI, fig. 18.***Histrio complanatus.* Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body subelliptical, much depressed, twice as long as broad, the posterior extremity obscurely pointed, the anterior evenly rounded; frontal lip crescentic, conspicuous; peristome field extending to near the centre of the ventral surface, the right-hand margin ciliated and bearing a membrane; frontal styles eight, five uncinat, with three smaller and setose; ventral styles five, one central, with two anteriorly and two posteriorly placed; anal styles five, the three on the right-hand side alone projecting beyond the body-margin; marginal setæ uninterrupted, longest and largest posteriorly; nuclei two, ovate; contractile vesicle spherical, situated near the centre of the left-hand border of the dorsal surface. Length of body $\frac{1}{320}$ inch. Dorsal hispid setæ short and inconspicuous. Habitat.—Shallow pools, in early spring.

The position of the contractile vesicle beneath the cuticular surface of the dorsum is well marked, and the enclosed fluid is evidently expelled through that surface.

As in most of the Hypotricha possessing what has been called the upper lip, this part is really not a continuation of the dorsum, but more nearly of the ventral surface, and the adoral cilia lie above the projection until they leave the anterior border to pass to the left-hand margin of the peristome field. This structural arrangement holds true in a majority of the lip-bearing Hypotricha, I believe in all.

HISTRIO INQUIETUS, Stokes. Pl. XII, fig. 1.*Histrio inquietus.* Stokes: Ann. and Mag. Nat. Hist., Aug., 1887.

Body elongate-obovate, about three times as long as broad, the extremities rounded; marginal setæ uninterrupted; anal styles five, occasionally six, the extremities often finely fimbriated; peristome field obovate, capacious, slightly curved towards

the left-hand side, the right-hand margin ciliate and bearing an undulating membrane continued around the anterior border; nuclei two, ovate; dorsal hispid setæ present. Length of body $\frac{1}{270}$ inch. Habitat.—Standing pond-water, with *Lemna*. Movements rapid.

HISTRIO ERETHISTICUS, Stokes. Pl. XII, fig. 2.

Histrio erethisticus. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Body subelliptical, less than three times as long as broad, both extremities rounded, the lateral borders flattened, nearly parallel; lip semicircular; peristome field reaching to the centre of the ventral surface, the right-hand margin bearing a membrane; frontal styles nine, the three anterior ones largest, the three posterior smallest, setose, inconspicuous; ventral styles five, more or less clustered, two on the right-hand side small, setose; anal styles large, stout, usually rigid, only the second and third on the right-hand side projecting beyond the posterior border; marginal setæ uninterrupted. Length of body $\frac{1}{170}$ inch. Habitat.—Shallow pools, with *Lemna* and Algæ.

The animalcule's movements during forward progression are constant, but not especially rapid, nor long extended in one direction, but it has a most annoying habit of suddenly darting backward, for a distance seldom exceeding its own length, yet, as it is impossible to anticipate the direction of this erratic movement, and as the change of position is extremely rapid, the eye fails to adjust itself soon enough to keep the creature distinctly visible. The infusorian continues these backward leaps incessantly when not swimming forward, consequently it is a difficult animalcule to study. Occasionally, especially after long confinement, two contractile vesicles become apparent, a small vacuole developing near the centre of the left-hand margin of the peristome, in advance of the large normal vesicle.

Genus *STYLONYCHIA*, Ehr.

STYLONYCHIA MYTILUS, Ehr.

STYLONYCHIA PUSTULATA, Ehr.

STYLONYCHIA PUTRINA, Stokes. Pl. XII, fig. 3.

Stylonychia putrina. Stokes: Am. Monthly Micros. Jour., Oct., 1885.

Body elongate-elliptical, less than three times as long as broad; the frontal extremity slightly widest, the posterior border evenly rounded or truncate; lateral margins flattened, almost parallel, or the left-hand border somewhat concave; peristome field extending to near the centre of the ventral surface, the right-hand border ciliate and bearing an undulating membrane; marginal setæ large, projecting posteriorly only; four of the five anal styles extending beyond the posterior border; caudal setæ short, arising from the dorsal surface; nucleus double, ovate; contractile vesicle single, on the left-hand side; immotile hispid setæ short, arranged in four longitudinal lines on the dorsum; endoplasm often filled with dark granules. Length of body $\frac{1}{175}$ to $\frac{1}{200}$ inch. Habitat.—A stale vegetable infusion. Movements rapid and erratic.

This is readily distinguishable from other species by the shape of the body, the elongated, subelliptical contour being thus far characteristic. The truncated posterior extremity is apparent only in the largest and presumably the oldest individuals, and not always with even them. Reproduction is by transverse fission, and by encystment with subsequent binary fission, the external cyst wall being smooth.

STYLONYCHIA VORAX, Stokes. Pl. XII, fig. 4.

Stylonychia vorax. Stokes: Am. Monthly Micros. Jour., Oct., 1885.

Body elongate, obovate, more than twice as long as broad, tapering and obtusely pointed, sometimes evenly rounded or obliquely truncate posteriorly; frontal border prominent, obliquely crescentic; lateral margins often flattened and parallel;

marginal setæ large, scarcely interrupted posteriorly, those on the left-hand side remote from the body-margin and projecting only at the posterior extremity; distal extremities of all the anal styles extending beyond the body-margin; caudal setæ stout, not widely separated, rising from the posterior margin of the body; peristome field extending to the centre of the ventral surface, the right-hand border nearly straight, ciliate and bearing an undulating membrane; contractile vesicle single, spherical, near the termination of the peristome, on the left-hand side; nucleus double, ovate; dorsal surface bearing one or more longitudinal rows of short, immotile, hispid setæ; frontal and anal styles often fimbriate. Length of body $\frac{1}{300}$ inch. Habitat.—Shallow ponds, in early spring.

This is the smallest member of the genus yet observed, and its characters are so obviously different from those of previously recorded species that it is easily recognizable. Two specially noteworthy features are that all the anal styles project beyond the body, and that the caudal setæ spring directly from the edge of the posterior border, and not, as in *S. mytilus*, Ehr., *S. notophora*, and *S. putrina*, from the dorsal surface.

The infusorian is voracious, devouring the numerous flagellate organisms so abundant in the shallow pools in early spring, until the body becomes not only colored by them, but gorged and often distorted by the internal pressure. It was this remarkable appetite that suggested the specific name.

STYLONYCHIA NOTOPHORA, *Stokes*. Pl. XII, fig. 5.

Stylonychia notophora. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body elliptical, more than twice as long as broad, the extremities subequal in breadth, the posterior one usually rounded and sometimes slightly emarginate on the right-hand side; the frontal border obtuse, the left-hand margin obliquely truncate, the right-hand corner obliquely emarginate; the upper lip prominent, crescentic; the inferior surface bearing eight frontal styles, the posterior three being smallest, and five ventral, with

five anal, of the latter the three on the right-hand side projecting beyond the posterior border; marginal setæ conspicuous, interrupted at the posterior extremity, longest and most numerous on the right-hand margin; caudal setæ long, widely separated and inserted on the dorsal surface of the posterior extremity; peristome field arcuate, extending to the centre of the ventral surface, its apical extremity terminating in a tubular ciliated pharyngeal passage sharply curved towards the right-hand side, the right-hand margin finely ciliate and supporting a conspicuous undulating membrane; nucleus ovate, double; contractile vesicle single, spherical, on the left-hand side of the peristome, near its posterior extremity; anal aperture on the left-hand side of the dorsal surface, somewhat in advance of the position of the anal styles, the dorsum also bearing four longitudinal rows of immotile hispid setæ; all the styles, as well as the marginal setæ, occasionally fimbriated. Length of body $\frac{1}{200}$ inch. Habitat.—Standing water with dead leaves, or with various aquatic plants.

Family EUPLOTIDÆ, Ehr.

Genus ASPIDISCA, Ehr.

ASPIDISCA COSTATA, (Duj.) Stein.

Genus GLAUCOMA, Ehr.

GLAUCOMA SCINTILLANS, Ehr.

Genus EUPLOTES, Ehr.

EUPLOTES PATELLA, Ehr.

EUPLOTES CHARON, (Müll.) Stein.

EUPLOTES VARIABILIS, Stokes. Pl. XII, fig. 6.

Euplotes variabilis Stokes: Ann. Mag. Nat. Hist., Aug., 1887.

Body elongate-obovate, nearly twice as long as broad, frontal border truncate; the lip prominent, crescentic; right-hand side of the posterior extremity obliquely truncate or somewhat concave, the left-hand side of that border rounded; right and left-hand body-margins usually convex, occasionally flattened and

nearly parallel, or slightly concave; dorsal surface minutely roughened, not carinate or furrowed; peristome field capacious, the posterior extremity of the right-hand border ciliate, the anterior extremity deeply excavate, disposed to be helicoidal; frontal styles six, long; ventral styles three; the two right-hand caudal setæ multifid, the two on the left-hand side simple; anal and frontal styles often fimbriate; nucleus very long, band-shaped. Length of carapace $\frac{1}{160}$ inch. Habitat.—Standing pond-water, with *Anacharis*.

The adoral cilia may here be divided into two groups according to the direction of their free extremities, those on the truncate frontal border being directed outwards from that margin, while those on the left-hand side of the peristome field are habitually vibrated and directed across and above that capacious excavation. The change of position takes place suddenly and is somewhat conspicuous.

The helicoidal flexure of the anterior portion of the peristome field is variable. At times it is deep and conspicuous; in other individuals it is only a slight notch, while in others again it may appear only as an irregular depression.

EUPLOTES PLUMIPES, *Stokes*. Pl. XII, figs. 7 and 8.

Euplotes plumipes. Stokes: Am. Monthly Micros. Jour., Dec., 1884.

Carapace irregularly suborbicular or elliptical, the right-hand body-half much thickened, the anterior margin truncate, often minutely crenulate or beaded, the upper lip crescentic and conspicuously projecting; posterior margin rounded, usually with a shallow emargination on the right-hand side of the median line; right-hand border rounded, or somewhat flattened and undulate; the anterior and posterior halves of the left-hand border commonly obliquely truncate in opposite directions and forming centrally a projecting and rounded angle or keel-like protuberance; peristome field wide, triangular, the upper right-hand corner prolonged in a sinistrally directed helicoidal curvature, posteriorly extending beyond the centre of the ventral

surface, the cilia of the anterior and left-hand borders large and cirrhone, the posterior portion only of the right-hand margin bearing cilia which are short and fine; styles confined to the right-hand half of the ventral surface, and consisting of six frontal, three ventral and five anal, the extremities of each of the last finely fimbriated; caudal setæ four, the two on the right-hand side of the median line much branched; dorsal surface convex, without longitudinal furrows, minutely roughened and often ornamented by longitudinal rows of equidistant elevations formed of minute prominences arranged in stellate clusters; contractile vesicle in the posterior body-half near the right-hand border; nucleus band-like, curved, very long, extending around nearly the entire periphery, its extremities separated by a short interval near the right-hand body-margin; anal aperture in close proximity to the contractile vesicle. Length of carapace $\frac{1}{200}$ inch. Habitat.—Pond-water, near the bottom.

The rounded angle projecting from the centre of the left lateral border is not always so conspicuous as in the figure, while it is occasionally even more marked. The ornamentation of the dorsal surface, shown in detail in figure 8, is not constantly so regular as there delineated nor so plainly developed. At times the stellate clusters are so prominent that they obtrude themselves upon the observer's attention; at others they consist of scattered dots or minute, elongated elevations collected into irregular and imperfectly star-like patterns.

Conjugation takes place by the union of the left-hand half of the ventral surfaces, and reproduction, in which there are some points of unusual interest, by transverse fission. The first noticeable change preceding the latter act is the appearance of a series of cilia almost parallel with the left-hand border of the peristome. From the comparatively vacant space over which the ventral styles are scattered, the zoöid soon gradually extrudes fourteen new styles, a second contractile vesicle appears and the animalcule presents the interesting aspect of an infusorian with

a double series of adoral cilia, two pulsating vacuoles, four caudal setæ and twenty-eight ambulatory styles. The body quite rapidly elongates until about twice the length of the ordinary animalcule, and separates across the middle, dividing up the twenty-eight styles so that the anterior moiety preserves the old frontal and ventral ones, and takes five of the new for its anal ones, extruding four fresh caudal setæ. The posterior portion therefore has the newly extruded frontal and ventral styles, the old anal ones and the old caudal setæ. But before final separation the posterior moiety extrudes four additional caudal setæ, and thus has twice as many as the normal complement. These old setæ are absorbed; not all at the same time, nor yet all in regular sequence, but when the newly extruded seta is completely formed then the old one is gradually merged into the zoöid's body; the more profusely fimbriated, being more complicated, are the last to appear and the last to be absorbed.

EUPLOTES CARINATA, *Stokes*. Pl. XII, figs. 9 and 10.

Euplotes carinata. Stokes: Am. Nat., May, 1885.

Carapace irregularly suborbicular, the frontal and right-hand borders evenly rounded, the posterior margin convex and usually emarginate on the right-hand side, the left-hand border rounded but obliquely truncate in opposite directions, thus forming a subcentral, rounded, protruding angle; dorsal surface traversed by a single conspicuous median and longitudinal keel or acute ridge, and by four to six longitudinal furrows; seven frontal, three scattered ventral, and five straight simple anal, styles; four unbranched caudal setæ, the two on the left-hand side close together but remote from the margin; peristome field narrow, arcuate, the posterior third of the right-hand border ciliated; nucleus band-shaped, long, semi-circular. Length of carapace $\frac{1}{376}$, greatest width $\frac{1}{500}$ inch. Habitat.—Standing water, with dead leaves.

CLASS III TENTACULIFERA, *Huxley*.Order SUCTORIA, *S. K.*Family ACINETIDÆ, *S. K.*Genus SPHEROPHYA, *C. & L.*SPHEROPHYA UROSTYLÆ, *Maupas*.Genus TRICHOPHYA, *C. & L.*TRICHOPHYA SINUOSA, *Stokes*. Pl. XII, fig. 11.*Trichophrya sinuosa*. *Stokes*: Proc. Am. Philos. Soc., xxiii, No. 124.

Body flattened, irregular in shape, the margins undulate and lobulate; tentacles fascicled, long, distinctly capitate, protruded from the marginal lobes, the clusters seldom exceeding five in number; contractile vesicles multiple, marginal; nucleus not observed. Length $\frac{1}{460}$ inch. Habitat.—Pond-water; attached by the entire lower surface to *Anacharis*. Movements slow.

This differs from *T. epistylidis*, *C. & L.*, in its much smaller size, and especially in the marginal arrangement of the tentacles. The latter are long, often three times the length of the body.

TRICHOPHYA EPISTYLIDIS, *C. & L.*

Observed by Prof. D. S. Kellicott on the zoödendria of *Carchesium polypinum*, in the vicinity of Buffalo, N. Y.

Genus PODOPHYA, *Ehr.*PODOPHYA FIXA, (*Müll.*) *Stein.*PODOPHYA LIBERA, *Perty.*PODOPHYA INCLINATA, *Kellicott*. Pl. XII, fig. 12.*Podophrya inclinata*. *Kellicott*: The Microscope, Aug., 1887.

Body subspherical or subpyriform, smooth, inclined to one side or overhanging the pedicle; tentacles not numerous, scattered on the anterior region, capitate; nucleus spheroidal, usually situated below the body-centre; contractile vesicles few, rarely more than two, small, anteriorly placed; endoplasm granular; pedicle from two to three times as long as the body, straight,

curved or sigmoid, usually narrowed below, rapidly widened or thickened above. Length, including pedicle, $\frac{1}{350}$ to $\frac{1}{250}$; length of body alone $\frac{1}{750}$ inch. Habitat.—Attached to the swimming-feet of *Cambarus* from the Niagara river.

PODOPHYA FLEXILIS, Kellicott. Pl. XII, fig. 14.

Podophrya flexilis. Kellicott: The Microscope, Aug., 1887.

Body subspherical, soft, changeable in shape, often transparent; surface smooth; tentacles few (two to four), flexible, very extensile, sometimes extending to six or more times the length of the body, and actively exploring the surrounding region; nucleus ovate, subcentral; contractile vesicle single, large, anteriorly placed; pedicle not exceeding one-half the body in length. Height $\frac{1}{1000}$ to $\frac{1}{500}$ inch. Habitat.—Attached to the pedicles of *Epistylis digitalis* on *Cyclops* from stagnant pools, in early spring.

Prof. Kellicott states that in the smaller individuals the anterior extremity is, by the plasticity of the body and its habit of swaying to and fro, often bent below the attachment of the pedicle, while the tentacles are incessantly exploring the neighboring region, like the long, extensile neck of *Trachelocerca olor*.

PODOPHYA CARCHESII, C. & L.

Observed by Prof. D. S. Kellicott on the zoödendria of *Curchesium polypinum*, near Buffalo, N. Y.

PODOPHYA CYCLOPUM, C. & L.

Observed by Prof. D. S. Kellicott on *Cyclops quadricornis*, near Buffalo, N. Y.

PODOPHYA QUADRIPARTITA, C. & L.

PODOPHYA BRACHYPODA, Stokes. Pl. XIII, fig. 4.

Podophrya brachypoda. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Body subspherical or broadly pyriform, commonly rounded posteriorly, subsessile, the pedicle being very short and incon-

spicuous; tentacles distinctly capitate, often twice as long as the diameter of the body, arranged in two, three or four fascicles; contractile vesicles two; nucleus ovate, coarsely granulate, subcentral or near the posterior extremity; endoplasm granular. Diameter of the body $\frac{1}{600}$ to $\frac{1}{750}$ inch. Habitat.—Standing water with dead leaves; attached to fragments and debris.

So abundant in its habitat was this *Podophrya* that a single dip of a small glass rod brought to the microscope-stage a dozen or more attached to floating fragments in the bacterial pellicle. The foot-stalk is here so short and inconspicuous, no previously observed *Podophrya* possessing so obscure a stem, that the infusorian may be recognized by this peculiarity. Unless seen in profile or side view, or in longitudinal optic section and attached to the supporting object, from which it is readily separated, it bears a not remote resemblance to *Spheroophrya*. In the figure the pedicle is shown of extreme length, being the longest observed among innumerable individuals. Ordinarily, it is not more than one-half the length there represented. In young or immature forms, which were as plentiful in the infusion as the larger, more distinctly pedicellate specimens, the foot-stalk is so rudimentary that the animalcules seem to be quite sessile, and the posterior point of attachment to be somewhat indented, thus giving that part the aspect of an adhesive acetabuliform disc. The latter is said to be conspicuous in *Podophrya Buckei*, S. K., so named by Kent from its discoverer, who described it, but failed to supply a specific title; and Kent intimates that, on account of this peculiar modification at the point of attachment, the creature may hereafter become the type of a new genus. In view, however, of the disc-like aspect of the adhesive extremity in the young *P. brachypoda*, I would suggest that *P. Buckei* is probably an immature form of an unobserved, more distinctly pedicellate member of the present genus.

The embryo of the present species is elongate-ovate, about three times as long as broad, and very active. It has two contractile vesicles and a conspicuous ovate nucleus. I have been

unable to follow the development, as all those seen to leave the parent have, within the confined space below the cover-glass, sooner or later fallen victims to the appetite of waiting *Podophryæ*.

PODOPHYRYA DIAPTOMI, *Kellicott*. Pl. XIII, fig. 8.

Podophrya Diaptomi. Kellicott: Proc. Am. Soc. Micros., 1885.

Body elongate-pyriform, plastic, less than three times as long as broad; tentacles numerous, capitate, arranged in three fascicles; nucleus spheroidal or ellipsoidal, subcentral; contractile vesicle single, near the centre of the anterior border; endoplasm anteriorly coarsely granular, finely so posteriorly; pedicle from one-half as long as the body to equal its length, subcylindrical, slightly curved, longitudinally striate, the body attached obliquely. Length of body $\frac{1}{200}$ inch. Habitat.—Attached to *Diaptomus* during the winter water-supply of Buffalo, N. Y.

The young are subspherical, with few, irregularly distributed tentacles.

PODOPHYRYA MACROSTYLA, *Stokes*. Pl. XIII, fig. 1.

Podophrya macrostyla. Stokes: Am. Monthly Micros. Jour., July, 1885.

Body subspherical; tentacles irregularly distributed over the entire surface, distinctly capitate; pedicle from seven to eight times as long as the diameter of the zoöid, large, hollow, widest at the point of attachment to the body; contractile vesicle single, laterally located; nucleus ovate, subcentrally placed; endoplasm usually coarsely granular. Diameter of the body $\frac{1}{450}$ to $\frac{1}{500}$ inch. Habitat.—Pond-water.

The tentacles extend until once and one-half to twice as long as the diameter of the body. They are usually surrounded externally by a spiral, thread-like film, or by irregular transverse or circular folds of sarcode distinctly visible with even a comparatively low amplification. These spirals, when the tentacle is retracted, are apparently forced close together and seem often to coalesce and form an irregular protoplasmic mass at the point of attachment to the body, as if the tentacle had for its basis a

rigid, internal, hollow filament which, when drawn into the body, was partially stripped of the external investment in its passage through the cuticular surface of the zoöid. That this internal support or rigid lining exists is scarcely possible, yet the outer wall of the tubular tentacle seems unusually firm. When first placed on the glass slide for examination and subjected to slight pressure of the cover, the creature has the habit of voluntarily throwing off the tentacles apparently in contact with the cover, which then float away as delicate, rod-like filaments with a loop or bulb at each end, as shown in figure 1. The separation is quickly accomplished, and the tentacle at once assumes the aspect of a fine thread, an anterior bulb or loop being formed from the capitate extremity, and a posterior one apparently from the protoplasmic contents. Other tentacles are almost immediately substituted, a fact militating against the apparent possession of a rigid tubular foundation. A similar separation takes place after submission to prolonged observation and the consequent deoxygenation of the water. What useful purpose this voluntary mutilation can subserve it is not easy to conjecture, and why the suctorial organs are not withdrawn and this waste of substance prevented it is equally difficult to imagine. Can the infusorian be without the ability to entirely withdraw the tentacles when once extruded? The suggestion seems plausible, and, indeed, I have not yet observed an individual without some trace of these organs protruding from the surface. In several instances tentacles have been partially withdrawn, and the extremity of the crowded external spirals of sarcode below the capitate bulb have become divided into numerous long, fine, vibratile filaments, as shown on two tentacles in figure 1. This formation has been observed only after the infusorian has been in confinement for a considerable period. It is therefore probably an evidence of discomfort, or a symptom of pathological change. Two tentacles on the same individual have been seen in this condition, but the infusorian did not appear to be weakened or ill at ease, as the remaining ones were fully extended,

or actively withdrawn and protruded. The appearance has not been previously observed, and it needs an explanation which is indeed difficult to make.

Genus SOLENOPHRYA, C. & L.

SOLENOPHRYA INCLUSA, Stokes. Pl. XIII, fig. 10.

Solenophrya inclusa. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Lorica subspherical, irregularly rounded or somewhat flattened posteriorly, bearing near the anterior border an irregular, equatorially disposed rim or projection, close to which the thin walls are pierced by narrow fissures for the exit of the four to six fascicles of distinctly capitate tentacles; animalcule elongate-ovate or subspherical, entirely enclosed, not attached to the lorica posteriorly; contractile vesicle single; nucleus ovate, coarsely granular. Diameter of lorica $\frac{1}{600}$ inch. Habitat.—Standing water; attached to *Proserpinaca* and other aquatic plants.

The margin of the sheath in most of the loricate members of the order to which the genus *Solenophrya* belongs is usually difficult to demonstrate distinctly; but in this particular species the frontal convexity or roof is so hyaline that its existence can be satisfactorily observed only by the use of some chemical means of removing the enclosed zoöid. This is readily accomplished by a drop or two of caustic potash in solution. The soft animal is thus entirely dissolved, the hyaline lorica remaining unchanged and in condition for examination. The lorica is then observed to be generally but irregularly spherical, the rounded contour being interrupted anteriorly by the conspicuous rim, the edge of which is also irregularly undulate and angular. The fascicles of tentacles seem to issue from fissures near this rim, as I have been unable to detect openings in the upper surface or dome-like roof of the lorica.

SOLENOPHRYA PERA, *Stokes*. Pl. XIII, fig. 9.

Solenophrya pera. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Lorica irregularly cubical or satchel-shaped, compressed anteriorly, membranous, hyaline, the greatest height, length, and breadth subequal, longest and widest at the base of attachment, narrowing to the anterior border, the sides more or less concave, the sloping ends truncate, the posterior angles rounded, a narrow elongate cleft extending along the entire frontal margin; enclosed animalcule oval, about twice as long as broad, not adherent to the lorica posteriorly; tentacles numerous, capitate, arising from the entire frontal border; contractile vesicle single, posteriorly placed; nucleus conspicuous, subspherical, coarsely granular, located somewhat in advance of the pulsating vacuole. Length and height of lorica $\frac{1}{600}$ inch, width $\frac{1}{644}$; length of animal $\frac{1}{750}$ inch, width $\frac{1}{1200}$ to $\frac{1}{1000}$ inch; two individuals often occupying the same lorica. Habitat.—Standing water; attached to *Myriophyllum* and other aquatic plants.

The form of this lorica is so much like that of the ordinary hand-satchel now popular among ladies, that it suggested the specific name. I have not observed the act of reproduction; but the presence of two individuals in one lorica suggests fission or budding, the usual method in the order being by the formation of a ciliated embryo.

SOLENOPHRYA ODONTOPHORA, *Stokes*. Pl. XII, fig. 15.

Solenophrya odontophora. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica cup or bowl-shaped, membranous, hyaline, the height about equal to the breadth, the posterior extremity rounded, the anterior border beneath the even, circular margin bearing from four to twelve attenuate, hollow, variously and inwardly curved, tooth-like processes; enclosed animalcule not adherent to the lorica; endoplasm finely granular. Height of the lorica, including the processes, $\frac{1}{1125}$ inch; length of the tooth-like pro-

cesses $\frac{1}{2250}$ inch. Habitat.—Pond-water; attached to *Myriophyllum*.

This form was first observed, and in considerable abundance, about four years ago, but has not since been met with. All the individuals then noted had withdrawn the tentacles, and had become encysted within the lorica. The tentacles have therefore never been seen. These encysted forms were undergoing one stage of reproduction. The entire endoplasm is subdivided into very minute, remarkably active, biflagellate germs.

Genus ACINETA, Ehr.

ACINETA ALATA, *Stokes*. Pl. XIII, figs. 2 and 3.

Acineta alata. *Stokes*: Am. Monthly Micros. Jour., Oct., 1885.

Lorica irregularly ovate, widest centrally, the length not greatly exceeding the breadth, tapering anteriorly to the rounded or obtusely pointed border, and posteriorly to the pedicle, the walls thin, transparent, continuous, traversed longitudinally by from five to eight posteriorly diverging, compressed, wing-like elevations, each pierced by about four ovate, equidistant, longitudinally arranged apertures for the passage of the fascicles; pedicle six to eight times as long as the lorica, straight or slightly curved, its hollow cavity continuous with that of the sheath; enclosed zoöid ovoid, somewhat changeable in shape, occupying the anterior part of the cavity of the lorica, apparently not attached to the walls; endoplasm granular; tentacles fasciculate, all the distinctly capitate extremities usually placed on the same side of the fascicle, each of which consists of about six tentacles; nucleus ovate, subcentral; contractile vesicle single, spherical, posteriorly situated near one lateral border. Length of lorica, with pedicle, $\frac{1}{56}$ inch; of the enclosed zoöid $\frac{1}{80}$ inch. Habitat.—Fresh water, on *Ceratophyllum*.

The projecting wing-like additions are very strongly flattened, the margins usually being undulate or irregularly crenate. It is difficult to rotate the lorica on its long axis so as to obtain a

view of all the projecting alæ in succession, and to be certain of the exact number, the observer being forced to content himself with an examination of the opposite surface through the entire thickness of the semi-transparent animalecule. The usual number seems to be five; it varies, however. I have not succeeded in obtaining an end view; figure 3, showing a horizontal optic section of the lorica, is therefore not only diagrammatic, but to a certain extent ideal. The tentacles rarely exhibit an external spiral film.

ACINETA FLAVA, *Kellicott*. Pl. XIII, fig. 13.

Acineta flava. Kellicott: Proc. Am. Soc. Micros., 1885.

Lorica triangular, compressed, finely striate longitudinally, less than twice as long as broad, not continuous anteriorly, attached to the pedicle by a flexible joint admitting of free movement to and fro; enclosed body not adherent, usually occupying the anterior half of the lorica, endoplasm granular, yellowish-brown in mature individuals, green in the young; tentacles short, capitate, in two antero-lateral fascicles; nucleus short band-like, thick, curved, subcentral near one lateral border; contractile vesicle single, subcentrally located, pedicle slender, straight or slightly curved, somewhat longer than the lorica. Length of sheath $\frac{1}{20}$ inch. Habitat.—Niagara river water, near Buffalo.

ACINETA FLUVIATILIS, *Stokes*. Pl. XIII, fig. 15.

Acineta fluvialis. Stokes: Am. Monthly Micros. Jour., Oct., 1885.

Lorica subtriangular, compressed, transparent, thin and delicate; about one and one-third times as long as broad, widest at the distal border, somewhat constricted anteriorly, thence tapering posteriorly to the pedicle; lateral borders flattened, the lorica thus presenting a quadrangular outline in horizontal optical section; frontal margins united anteriorly except at the two ovate antero-lateral apertures for the passage of the tentacles; pedicle short, not exceeding one-third the length of the lorica,

usually slightly widened at the distal extremity; enclosed zoöid generally entirely filling the cavity of the lorica, to which it is attached at the posterior extremity and apparently by the entire lateral surface; endoplasm granular; tentacles distinctly capitate, in two antero-lateral fascicles; contractile vesicle single, spherical, anteriorly situated; nucleus ovate or broadly sub-spherical, conspicuous, subcentrally located. Length of lorica $\frac{1}{300}$ to $\frac{1}{600}$ inch. Habitat.—On *Valisneria spiralis* from a tide-water creek.

This may be regarded as the connecting link between the marine *Acineta tuberosa*, Ehr., and the fresh-water *A. lemnarum*, Stein, both of which it resembles in the form of the lorica. Its systematic position is evidently between these species. From *A. tuberosa* it conspicuously differs in the short pedicle, the apparent adhesion of the entire body to the internal walls of the lorica, except at the anterior or distal border, and by its fresh-water habitat. The irregularly quadrilateral outlines of the loricae in horizontal optical section are similar, as well as the habit, possessed by both, of withdrawing the entire fascicle of tentacles at one time. In *A. tuberosa*, however, the tentacles do not possess the external spiral ridge-like film often visible in *A. fluvialilis*. The latter may very justly be considered the fresh-water representative of the marine type. From *A. lemnarum* it is recognizable chiefly by the short pedicle, the posterior adhesion to the lorica, and especially by the presence of but a single contractile vesicle.

The lorica walls are often seen to be variously indented, bent and folded, the entire lorica being often reversed or inclined either by contact with *Rotiferæ* or other comparatively large denizens of its habitat, or by the necessary manipulations of the observer. Occasionally a portion of the soft body exudes through the apertures at the antero-lateral angles, thus lifting the extended tentacles for some distance beyond the walls; in a single instance a fascicle was entirely withdrawn and an irregular, curved process of sarcodæ was extruded from the tentacular

orifice until its length equalled that of the entire infusorian, its shape and position slowly changing, a few minute vesicles appearing in it, but until I was compelled to leave the microscope, no further alterations took place. The next morning the extruded part had been partially withdrawn, but the creature was weakened by prolonged confinement and the tentacles were not protruded. The act may have been induced by the discomforts of extended imprisonment, and the consequent diminution of the oxygen-supply.

The spiral film external to the tentacles is not always present. It is most frequently developed during the withdrawal or partial extension of the tentacle, when it is thrown into irregular, closely approximated ridges, the full extension of the organ elongating the spirals until they become merged into its substance.

At the systole of the contractile vesicle a narrow channel very frequently becomes visible, leading from the vacuole to the distal border of the zoöid.

ACINETA LACUSTRIS, *Stokes*. Pl. XIII, fig. 11.

Acineta lacustris. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124.

Lorica elongate-obovate or subvasiform, strongly compressed, less than three times as long as broad, widest anteriorly, the sides continuous across the frontal border, leaving a rounded lateral aperture at each angle for the exit of the tentacles; slightly constricted beneath the anterior border, and very moderately inflated near the posterior extremity, the frontal margin concave; pedicle very short and hollow; enclosed zoöid often entirely filling the cavity of the lorica; tentacles in two antero-lateral fascicles, distinctly capitate; contractile vesicle single, placed near the anterior border; nucleus elongate, vertical; endoplasm granular. Length of the lorica $\frac{1}{345}$ to $\frac{1}{140}$ inch. Habitat.—Pond-water; attached to *Anacharis*.

ACINETA STAGNATILIS, *Stokes*. Pl. XIII, fig. 12.

Acineta stagnatilis. Stokes: Proc. Am. Philos. Soc., xxiii, No. 124.

Lorica subcircular in outline, rounded and inflated posteriorly, compressed anteriorly, the frontal border irregularly convex; pedicle short, hollow, from one-fourth to one-fifth as long as the lorica, widest at its junction with the sheath, tapering thence and terminating in a button-like point of attachment; frontal margin pierced by a slit-like fissure, and two anteriorly converging, narrow fissures on the front and rear walls, for the exit of the tentacles; the enclosed animalcule occupying the centre of the lorica, apparently not attached to the walls, subspheroidal, the anterior border truncate; tentacles more or less fascicled, capitate; contractile vesicle single, postero-lateral; endoplasm granular. Length of the lorica, including pedicle $\frac{1}{450}$ inch. Habitat.—Pond-water; on *Myriophyllum*.

ACINETA CUSPIDATA, *Kellicott*. Pl. XIII, fig. 19.

Acineta cuspidata. Kellicott: Proc. Am. Soc. Micros., 1885.

Lorica cup-shaped, the anterior border bearing two, opposite central cusps or long points; enclosed body spheroidal or sub-cylindrical, not entirely filling the cavity of the lorica, often projecting above the anterior border; tentacles in two antero-lateral groups, extensile, flexible, slightly thickened at the distal extremities; contractile vesicle single, anteriorly placed; nucleus not observed; pedicle short, about one-twelfth as long as the lorica. Height of sheath $\frac{1}{800}$ to $\frac{1}{600}$ inch. Habitat.—Attached to *Edogonium* at Point Abino, Ontario.

ACINETA URCEOLATA, *Stokes*. Pl. XII, fig. 13.

Acineta urceolata. Stokes: Ann. and Mag. Nat. Hist., June, 1885.

Lorica urceolate, widest and compressed anteriorly, the walls thin, readily taking the form of the enclosed animalcule, the posterior extremity continued as an attenuate, very short, hollow

pedicle one-eighth to one-tenth as long as the lorica, the frontal margins separated by a narrow cleft-like fissure, widened and rounded at the lateral borders; enclosed body almost filling the cavity of the lorica, and attached to it posteriorly by a prolongation continued through the pedicle; endoplasm granular; tentacles capitate, a fascicle issuing from each lateral angle of the anterior fissure; nucleus oval, near the posterior extremity; contractile vesicle spherical, single, near the posterior part of one lateral border. Length of lorica, including pedicle $\frac{1}{60}$ inch. Habitat.—Standing water, with various aquatic plants.

ACINETA MYSTACINA, *Ehr.*

ACINETA MACROCAULIS, *Stokes*. Pl. XIII, figs. 6 and 7.

Acineta macrocaulis. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica obovate or subspherical. Lorica obovate, the length only slightly exceeding the width, flexible, continuous, taking the form of the enclosed zoöid, the anterior border rounded, the lateral margins almost straight, tapering to the pedicle. Lorica subspherical, the anterior border slightly undulate, the anterior extremity of the pedicle suddenly expanded. Pedicle from seven to nine times as long as the lorica, hollow, its cavity continuous with that of the sheath; enclosed body usually entirely filling the lorica, soft, changeable in shape, not attached posteriorly to the sheath; endoplasm granular, enclosing numerous, large, refractive, probably amylaceous corpuscles; tentacles irregularly distributed at the anterior border, distinctly capitate, exhibiting spiral folds during their retraction; contractile vesicle apparently single, posteriorly placed near one lateral border; nucleus not observed. Length, including pedicle, $\frac{1}{100}$ to $\frac{1}{70}$ inch. Habitat.—Pond-water; attached to *Myriophyllum*.

ACINETA LAPPACEA, *Stokes*. Pl. XIII, fig. 5.

Acineta lappacea. Stokes: Am. Monthly Micros. Jour., Oct., 1885.

Lorica hyaline, subspherical, the borders projecting outwardly in numerous conspicuous, irregularly distributed tubuli through

which issue the fine tentacles; pedicle slender, often flexuous, two to three times as long as the lorica; enclosed body subglobose, not attached to the lorica posteriorly; nucleus small, spherical, subcentral; contractile vesicles several, small, scattered. Diameter of the lorica $\frac{1}{1500}$ to $\frac{1}{1900}$ inch; of the enclosed zoöid $\frac{1}{3000}$ inch; length of pedicle $\frac{1}{750}$ to $\frac{1}{500}$ inch. Habitat.—Pond-water; on rootlets of *Lemna* and on *Riccia fluitans*.

This approaches more nearly to *A. stellata*, S. K., than to any other member of the genus, differing from it in the greatly increased length of the pedicle, and in the multiple contractile vesicles. The tentacles are very fine, but exhibit conspicuous, irregular protoplasmic thickenings. Their length is often twice the diameter of the lorica. They vary in number from fourteen to eighteen or more. They are apparently not capitate.

ACINETA BIFARIA, *Stokes*. Pl. XIII, figs. 16, 17 and 18.

Acineta bifaria. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica, in side view, oval, the longest diameter less than twice the height; seen from above, orbicular; the entire surface minutely tuberculate; pedicle very short, often only a small, inconspicuous, button-like projection; enclosed body attached to the posterior extremity only of the lorica, and divided into two unequal parts, the posterior region often entirely filling the cavity of the sheath, occasionally only about one-half filling it, the anterior portion subspherical, habitually extruded beyond the lorica aperture, and bearing the scattered capitate tentacles, the posterior or loricate portion often coarsely and longitudinally striate; endoplasm granular; contractile vesicles two, spherical, one situated near the lateral border of the anterior body-half, the other on the opposite side of the posterior or loricated region; nucleus apparently broadly ovate or subspherical, anteriorly placed; reproduction by transverse fission of the extruded anterior region, the embryo hypotrichous. Diameter of the lorica $\frac{1}{560}$ inch. Habitat.—An infusion of hay.

The first noticeable sign of approaching reproductive fission

consists in an increased extrusion of the body substance, speedily followed by the formation of fine cilia on the anterior surface, with the appearance of a transverse constriction subcentrally situated on the extruded portion, as in figure 17. This constriction deepens, the cilia increase in length, soon entirely clothing the frontal region and one lateral margin, and, by the time the division is completed, the posterior border as well. At the final separation of the embryo it is ovate, coarsely granular, with a somewhat conspicuous nucleus. It speedily becomes elongated and flattened, as in figure 18, its length exceeding the height of the mature animalcule. The cilia are confined to the extremities and the lower surface, while a few short, capitate tentacles are scattered over the superior aspect. After the departure of the embryo the remaining portion of the mature animalcule withdraws itself into the lorica, as in figure 16, the anterior, subspherical region remaining exposed and the tentacles protruded. The latter become fewer in number, but are not entirely withdrawn during the reproductive act. After it they become more numerous.

The presence of the short, button-like pedicle of some individuals gives the lorica an appearance closely resembling that of *Solenophrya*, to which genus they might readily be relegated if not seen scattered among the more abundant and more distinctly pedicellate forms.

ACINETA ACUMINATA, *Stokes*. Pl. XIII, fig. 14.

Acineta acuminata. Stokes: Proc. Am. Philos. Soc., xxiv, 126, 1887.

Lorica broadly vasiform, slightly longer than broad, the posterior border rounded, the anterior continuous, obliquely truncate on each side, and produced centrally in a prominent acumination, the lateral angles also often acuminately prolonged; the anterior borders on each side separated by a slit-like aperture, and the front wall bearing two narrow, anteriorly converging fissures for the passage of the tentacles; pedicle hollow, from one-third to one-half as long as the lorica and communi-

eating with its cavity; enclosed body subspherical, attached to the lorica anteriorly only and there taking the form of the sheath; tentacles fine, capitate, scarcely clustered; contractile vesicle single, spherical, situated near one side of the posterior extremity; nucleus large, subcentral; endoplasm granular. Length of lorica $\frac{1}{500}$ inch; of pedicle $\frac{1}{1500}$ to $\frac{1}{1125}$ inch. Habitat.—Pond-water.

The lateral angles are sometimes produced, sometimes rounded; and occasionally one will be rounded and the other slightly produced. The anterior central acumination has been present in all the forms observed. That only one wall of the lorica should be pierced by the two converging fissures is noteworthy. Corresponding lines on the opposite wall could not be perceived, although careful search was made for them.

Family DENDROCOMITIDÆ, *S. K.*

Genus DENDROCOMETES, *Stein.*

DENDROCOMETES PARADOXUS, *Stein.*

Observed near Buffalo, N. Y., by Prof. D. S. Kellicott.

Family DENDROSOMIDÆ, *S. K.*

Genus DENDROSOMA, *Ehr.*

DENDROSOMA RADIANS, *Ehr.*

Observed near Philadelphia by Dr. Joseph Leidy, and at Buffalo, N. Y., by Prof. D. S. Kellicott.

PLATE I.

Fig.

- 1-4. *Mastigamœba longifilum*, p. 72.
5. *Actinomonas vernalis*, p. 72.
6. *Acinetactis mirabilis*, p. 75.
7. *Bicosœca lepteca*, p. 75.
8. " *leptostoma*, p. 76.
9. " *acuminata*, p. 77.
10. " *dissimilis*, p. 78.
11. " *longipes*, p. 79.
12. *Stylobryon Abbotti*, p. 79.
- 13, 14. *Physomonas elongata*, p. 81.
15. " *vestita*, p. 82.
- 16, 17. *Anthophysa stagnatilis*, p. 83.
18. *Cryptoglena truncata*, p. 85.
19. *Chloromonas pulcherrima*, p. 85.
20. *Euglena torta*, p. 86.
- 21-23. *Chrysomonas pulchra*, p. 87.
24. *Trachelomonas torta*. (After Kellicott), p. 87.
25. " *piscatoris*. (After Fisher), p. 88.
26. " *urceolata*, p. 89.
27. *Cyclanura orbiculata*, p. 89.
28. *Phacus acuminatus*, p. 90.
29. " *anacœlus*, p. 91.
30. *Chloropeltis monilata*, p. 91.
31. *Atractonema tortuosa*, p. 92.
32. *Mallomonas litomesa*, p. 92.
33. *Urceolus cyclostoma*. (After Stein), p. 93.
- 34, 35. *Urceolopsis sabulosa*, p. 95.
- 36, 37. *Petalomonas disomata*, p. 96.
38. " *pleurosigma*, p. 97.
39. " *dorsalis*, p. 98.
40. " *carinata*, p. 99.
41. " *alata*, p. 101.
- 42-46. *Heteromita variabilis*, p. 104.
47. " *mutabilis*, p. 103.
48. *Anisonema solenotus*, p. 107.
49. " *pusilla*, p. 107.

PLATE I

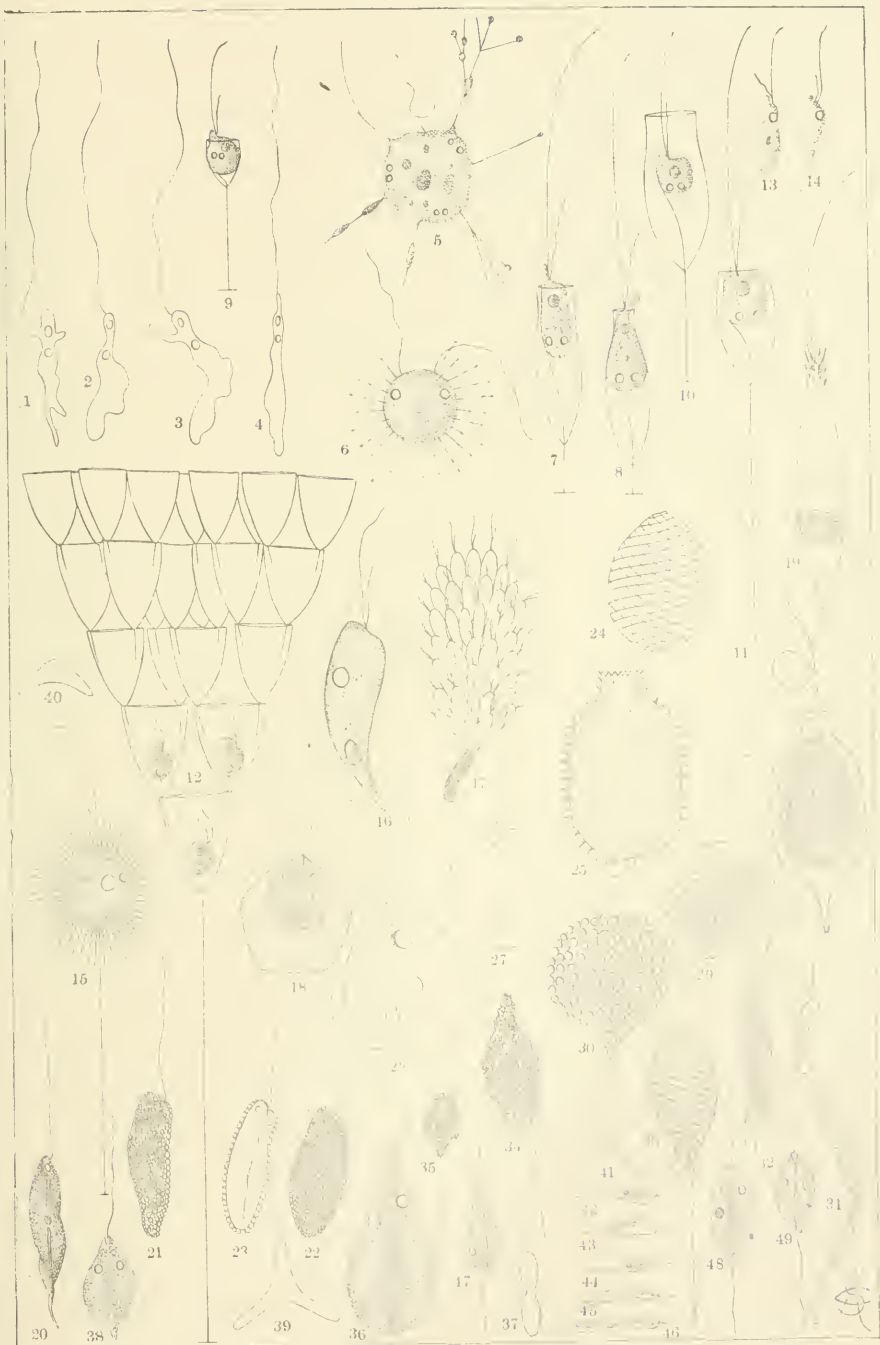


PLATE II.

Fig.

- 1-4. *Zygoselmis mutabilis*, p. 102.
5. " *acus*, p. 102.
- 6, 7. *Heteromita putrina*, p. 105.
8. *Anisonema emarginata*, p. 106.
9. *Entosiphon ovatus*, p. 108.
- 10, 11. *Notosolenus apocamptus*, p. 109.
- 12, 13. " *sinuatus*, p. 110.
14. " *orbicularis*, p. 111.
15. *Clostenema socialis*, p. 112.
16. *Chrysopyxis urceolata*, p. 113.
17. " *triangularis*, p. 114.
18. " *macrotrachela*, p. 114.
19. " *ampullacea*, p. 114.
- 20, 21. " *dispar*, p. 115.
22. *Derepyxis amphora*, p. 116.
23. " *ollula*, p. 116.
- 24-26. *Tetramitus variabilis*, p. 118.
- 27-29. *Chilomonas ovata*, p. 123.
- 30, 31. *Cyclonexis annularis*, p. 117.
32. *Exechlyga acuminata*, p. 119.
33. *Hexamita spiralis*, p. 121.
34. *Opalina flava*, p. 184.

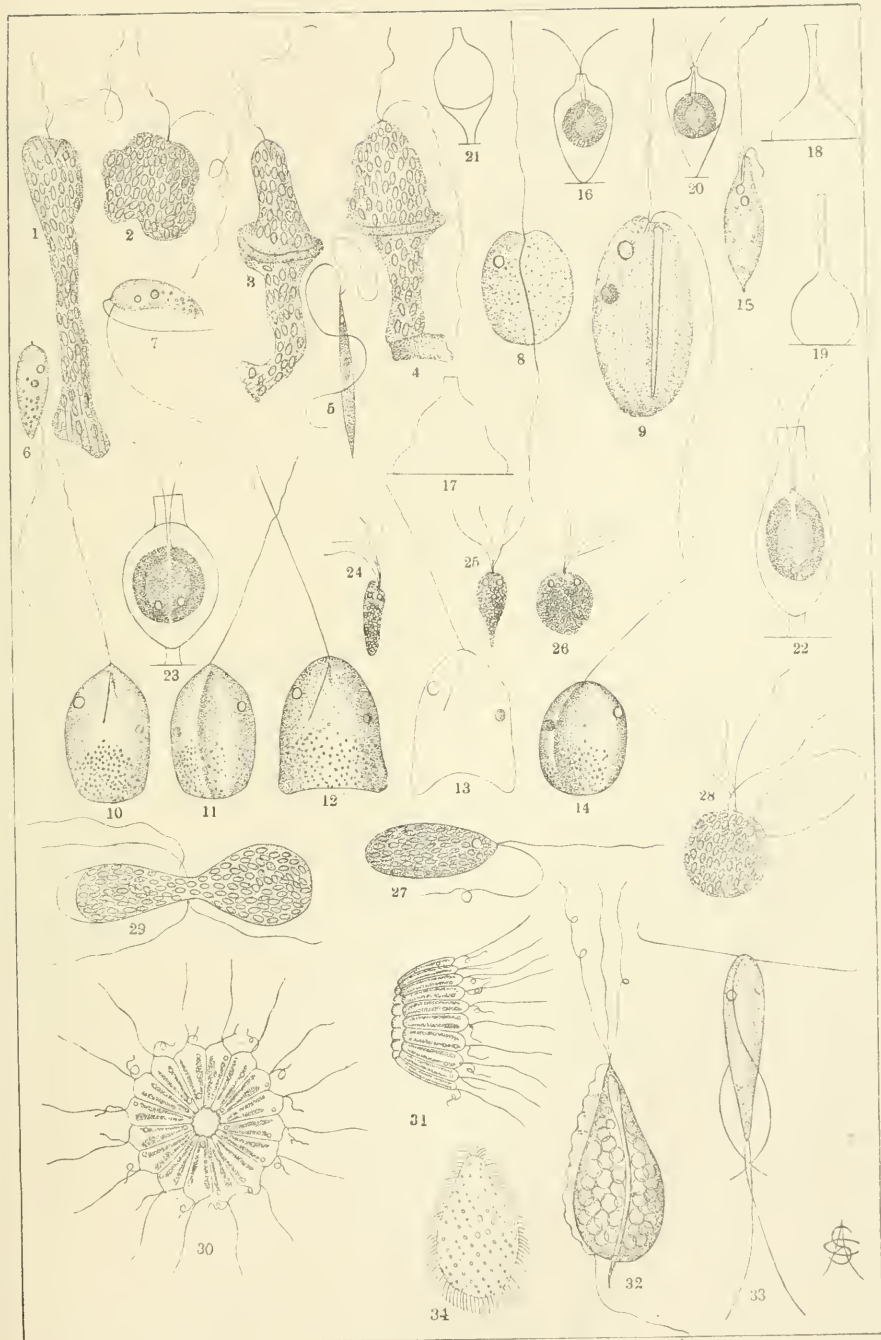


PLATE III.

Fig.

1. *Hexamita gyrans*, p. 121.
2. *Salpingœca acuminata*, p. 138.
3. *Trentonia flagellata*, p. 125.
4. *Tetraselmis limnetis*, p. 118.
5. *Codosiga longipes*, p. 129.
6. *Monosiga robusta*, p. 126.
7. " *Woodiæ*, p. 127.
8. " *obovata*, p. 127.
9. " *longipes*, p. 127.
10. " *limnobia*, p. 128.
11. *Desmarella irregularis*, p. 135.
12. *Salpingœca sphæricola*, p. 140.
13. *Codosiga utriculus*, p. 128.
14. *Salpingœca eurystoma*, p. 139.
15. " *lagenella*, p. 139.
16. *Codosiga florea*, p. 130.
17. " *magnifica*, p. 135.
18. *Salpingœca urceolata*, p. 137.
19. *Codosiga Kentii*; pedicle, p. 132.
20. " *dichotoma*, p. 132.
- 21, 22. " *umbellata*; pedicles, p. 132.

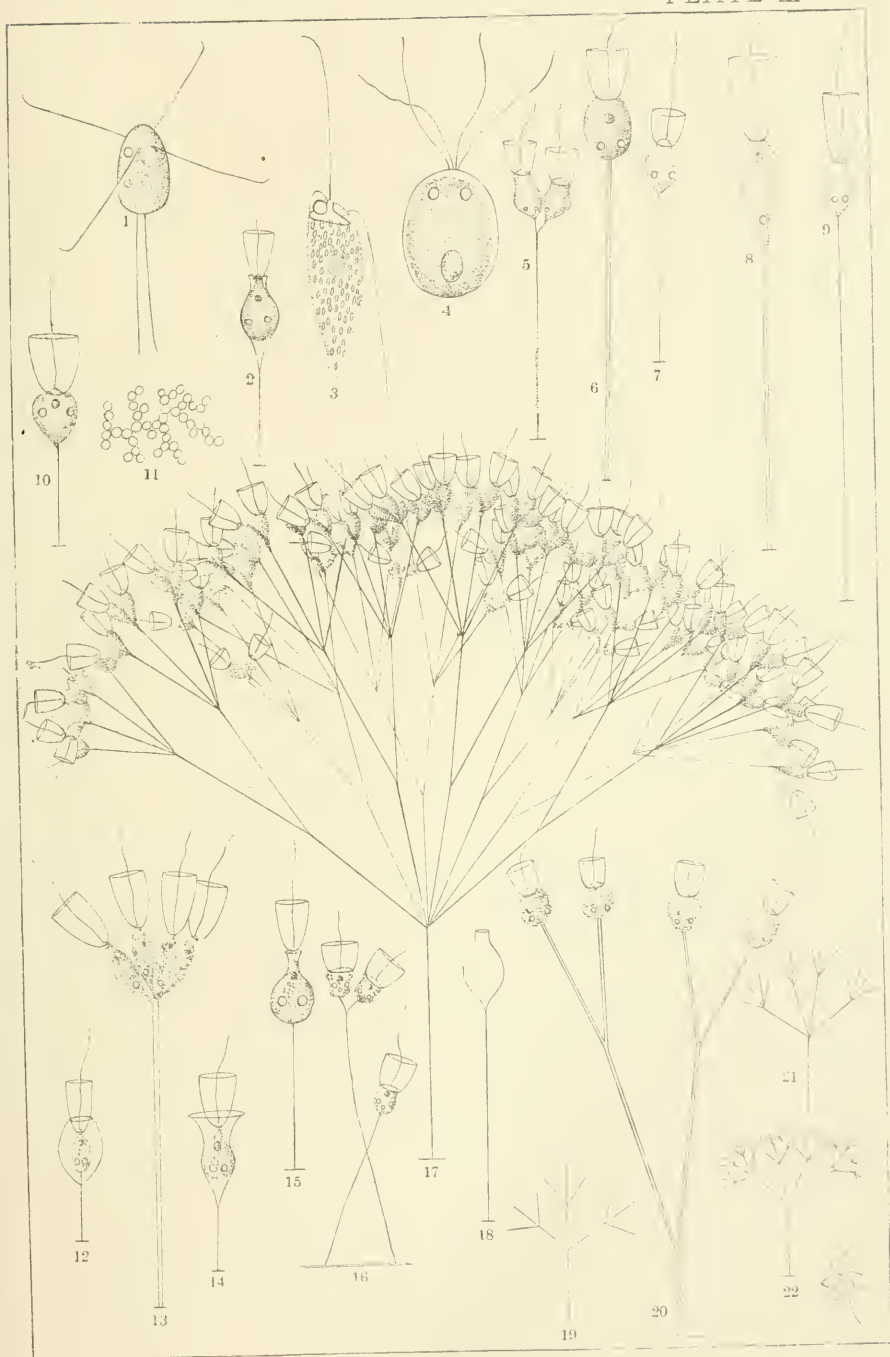


PLATE IV.

Fig.

1. *Proto-peridinium limbatum*, p. 141.
2. *Neonema dispar*, p. 145.
3. *Paramæcium aurelia*, p. 147.
4. " *trichium*, p. 147.
5. " " *trichocyst*, p. 149.
6. *Prorodon limnetis*, p. 149.
7. *Dexiotricha plagia*, p. 151.
8. *Trachelophyllum clavatum*, p. 154.
9. " *tachyblastum*, p. 153.
10. " *vestitum*, p. 155.
11. *Dexiotricha centralis*, p. 152.
12. *Urotricha platystoma*, p. 156.
13. *Perispira strephosoma*, p. 156.
14. *Colpoda depressa*, p. 157.
15. *Tillina helia*, p. 158.
16. " *flavicans*, p. 159.
17. *Lagynus lasius*, p. 166.
18. *Lacrymaria vertens*, p. 164.
19. " *teres*, p. 164.
20. *Tillina campyla*, p. 159.
21. " *saprophila*; mature, p. 160.
22. " " *young form*, p. 160.
23. *Lacrymaria truncata*, p. 165.
24. *Saprophilus agitatus*, p. 181.
25. *Tillina inflata*, p. 163.
26. *Loxophyllum flexilis*, p. 169.
27. *Colpidium truncatum*, p. 176.
28. " *striatum*, p. 177.
29. *Ophryoglena ovata*, p. 170.
30. *Dallasia frontata*, p. 171.
31. " " *reproductive fission*, p. 171.
32. *Amphileptus monilatus*, p. 167.

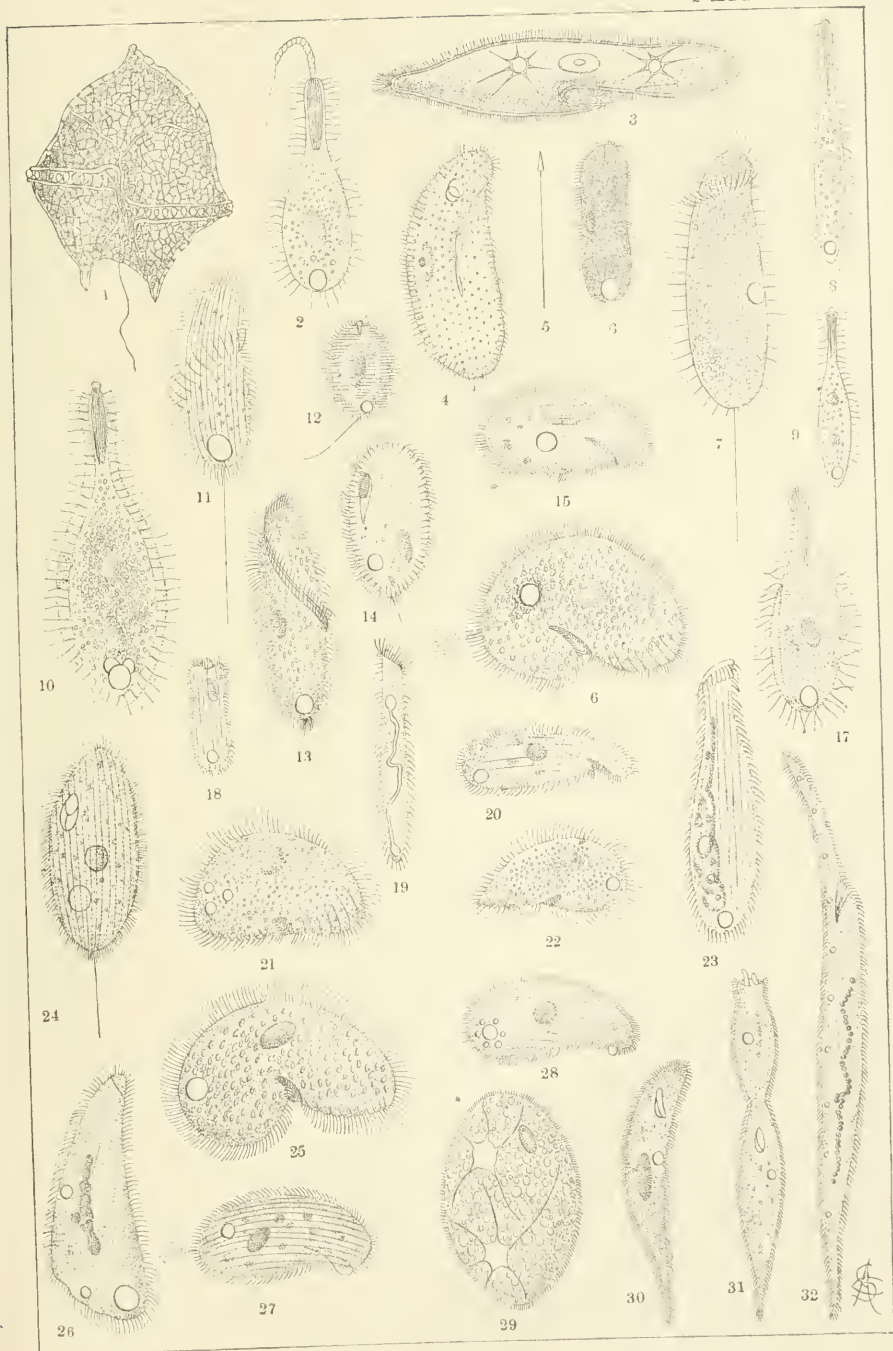


PLATE V.

Fig.

1. *Loxophyllum vorax*, p. 168.
2. *Hymenostoma hymenophora*, p. 173.
3. " *magna*, p. 175.
4. *Colpidium putrinum*, p. 176.
5. *Histobalantium agile*; dorsal aspect, p. 178.
6. *Bothrostoma undulaus*, p. 198.
7. *Histobalantium agile*; lateral aspect, p. 178.
8. *Calyptotricha inhæsa*; lorica. (After Kellicott), p. 182.
9. " " " (After Kellicott), p. 182.
10. *Cyclidium litomesum*, p. 183.
11. *Metopides striata*. (After McMurich), p. 186.
12. " *acuminata*, p. 187.
13. *Ctedoctema acanthocrypta*; dorsal aspect, p. 188.
14. " " lateral aspect, p. 188.
15. " " ventral aspect, p. 188.
16. " " trichocyst, p. 191.
17. *Stentor globator*, p. 203.
18. " " extruded caudal appendage, p. 203.
19. *Balanitozoön agile*, p. 213.
20. " *gyrans*, p. 213.
21. *Mesodinium recurvum*. (After Kellicott), p. 211.

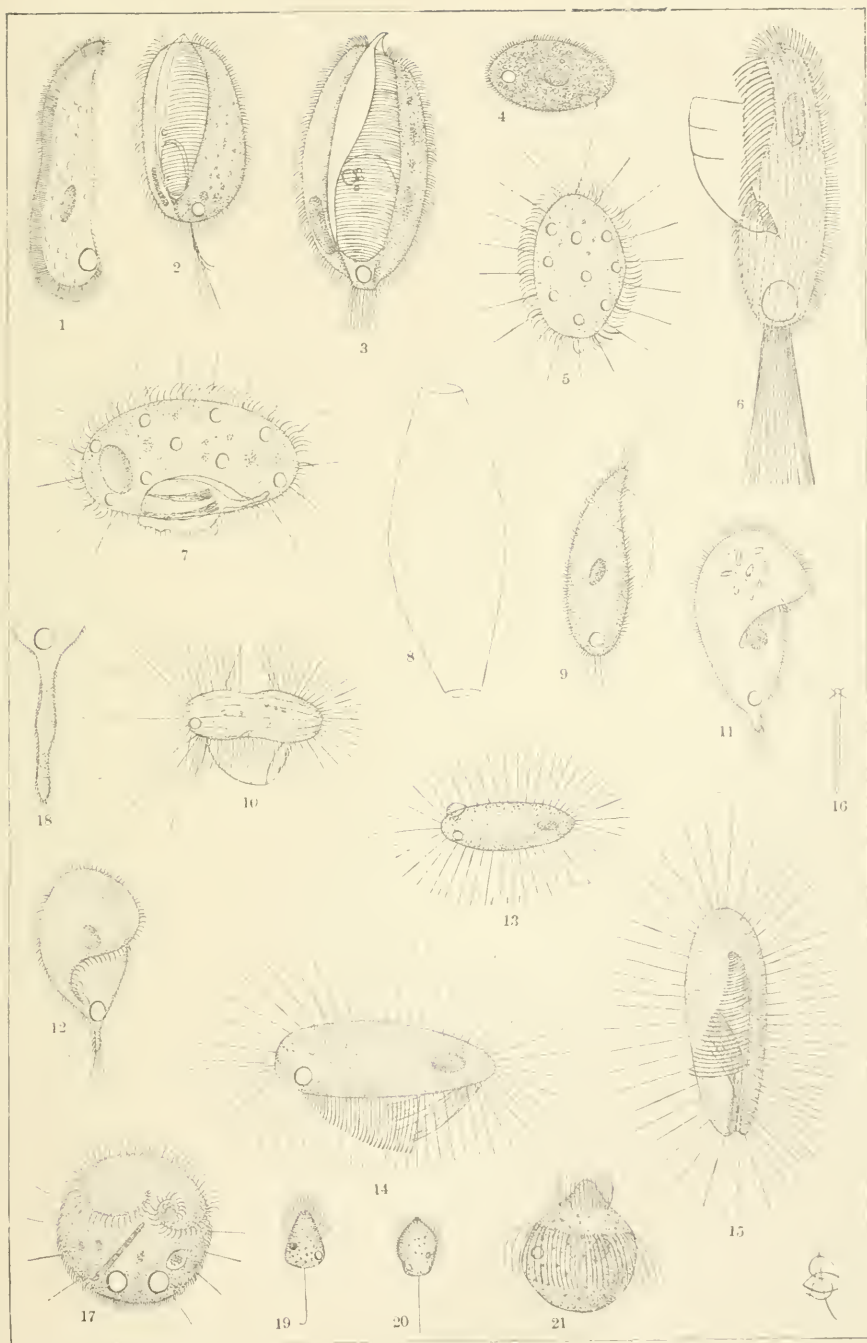


PLATE VI.

Fig.

1. *Cyrtolophosis mucicola*, p. 193.
2. *Apgaria undulans*, p. 195.
3. " *elongata*, p. 196.
4. " " *extruded caudal appendage*, p. 196.
5. " *ovata*; *caudal appendage withdrawn*, p. 197.
6. " " *reproductive fission*, p. 197.
7. *Spirostomum loxodes*, p. 199.
8. *Leucophrys emarginata*, p. 200.
9. " " *amylaceous endoplasmic plates*, p. 200.
10. " *curvilata*, p. 202.
11. *Strombidinopsis setigera*, p. 208.
12. " *acuminata*, p. 207.
13. *Holophrya ornata*, p. 150.
14. *Mesodinium fimbriatum*, p. 211.
15. *Strombidium gyrans*; *front*, p. 209.
16. " " *side*, p. 209.
17. *Gerda vernalis*, p. 214.
18. " *sigmoides*. (After Kellicott), p. 215.
19. *Scyphidia ovata*. (After Kellicott), p. 216.
20. " *constricta*, p. 216.
21. *Rhabdostyla chæticola*, p. 217.
22. " *invaginata*, p. 218.
23. " *vernalis*, p. 218.
24. " " *reproductive cyst*, p. 218.
25. *Pyxidium vernale*, p. 220.
26. " *invaginatum*, p. 221.
27. " *urceolatum*, p. 220.
28. *Lagenophrys labiata*, p. 261.
29. " *patina*, p. 260.
30. *Platycola coelochila*, p. 260.

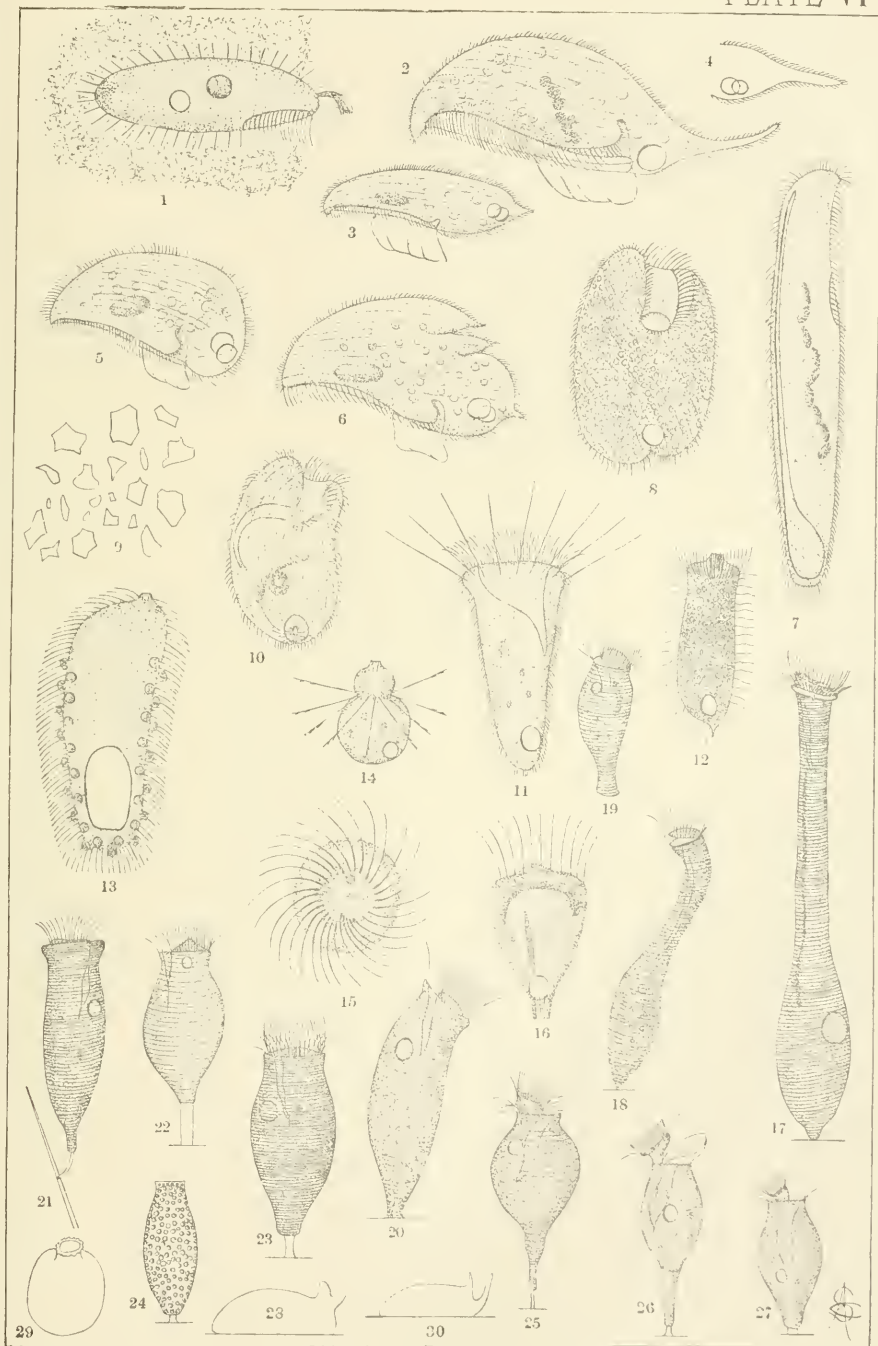


PLATE VII.

Fig.

1. *Opisthostyla pusilla*, p. 222.
- 2, 3. " *annulata*, p. 222.
4. *Vorticella limnetis*, p. 228.
5. " *aquæ-dulcis*, p. 229.
6. " *utriculus*, p. 230.
7. " *macrophyta*, p. 230.
8. " *macrocaulis*, p. 231.
9. " *octava*, p. 231.
10. " *Floridensis*, p. 232.
11. " *platysoma*, p. 232.
12. " *Lemnæ*, p. 232.
13. " *pusilla*, p. 233.
14. " *parasita*, p. 233.
15. " *similis*, p. 234.
16. " *conica*, p. 234.
17. " *rhabdophora*, p. 236.
18. " *vernalis*, p. 237.
- 19, 20. " *smaragdina*, p. 237.
- 21, 22. " *Lockwoodii*, p. 238.
23. *Stylohedra lenticula*. (After Kellicott), p. 262.

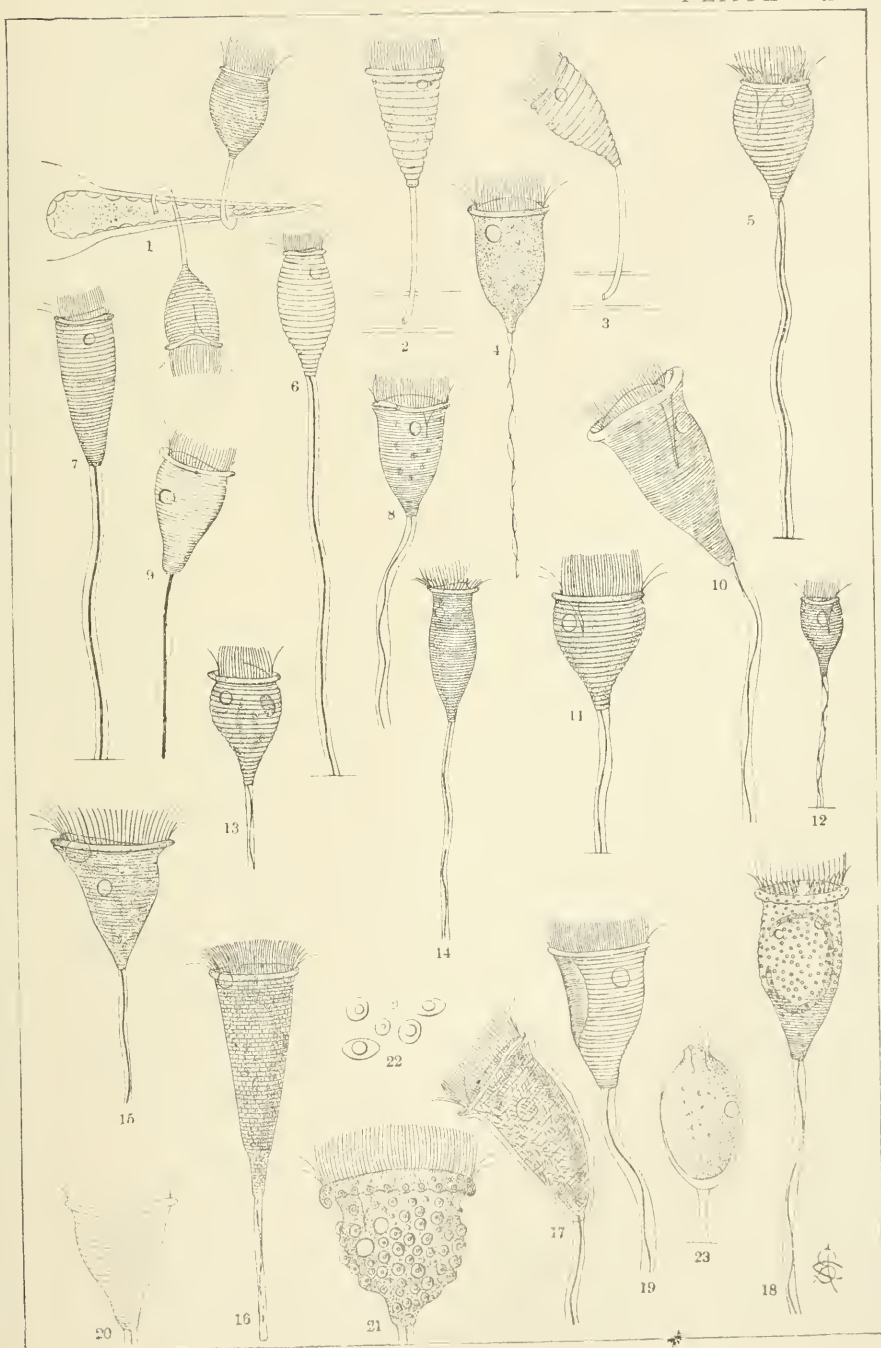


PLATE VIII.

Fig.

1. *Carchesium granulatum*. (After Kellicott), p. 240.
2. *Zoöthamnium Adamsi*, p. 241.
3. *Epistylis fugitans*. (After Kellicott), p. 243.
4. " *Cambari*. (After Kellicott), p. 243.
5. " " single zoöid. (Kellicott), p. 243.
6. *Platycola intermedia*, p. 260.
7. *Epistylis Niagaræ*, p. 244.
- 8, 9. " *ophidioidea*. (After Kellicott), p. 245.
10. *Cothurnia Canthocampti*, p. 256.
11. *Epistylis vaginula*; portion of colony, p. 244.
12. " " single zoöid, p. 244.
13. *Vaginicola ampulla*, p. 252.
14. *Opercularia humilis*. (After Kellicott), p. 246.
15. " *constricta*. (After Kellicott), p. 247.
- 16, 17. *Cothurnia bipartita*, p. 258.
- 18, 19. " *lata*. (After Kellicott), p. 256.
20. " *annulata*, p. 257.
21. *Pyxicola constricta*, p. 259.
22. *Cothurnia plectostyla*, p. 256.
- 23-26. " *variabilis*. (Kellicott), p. 255.

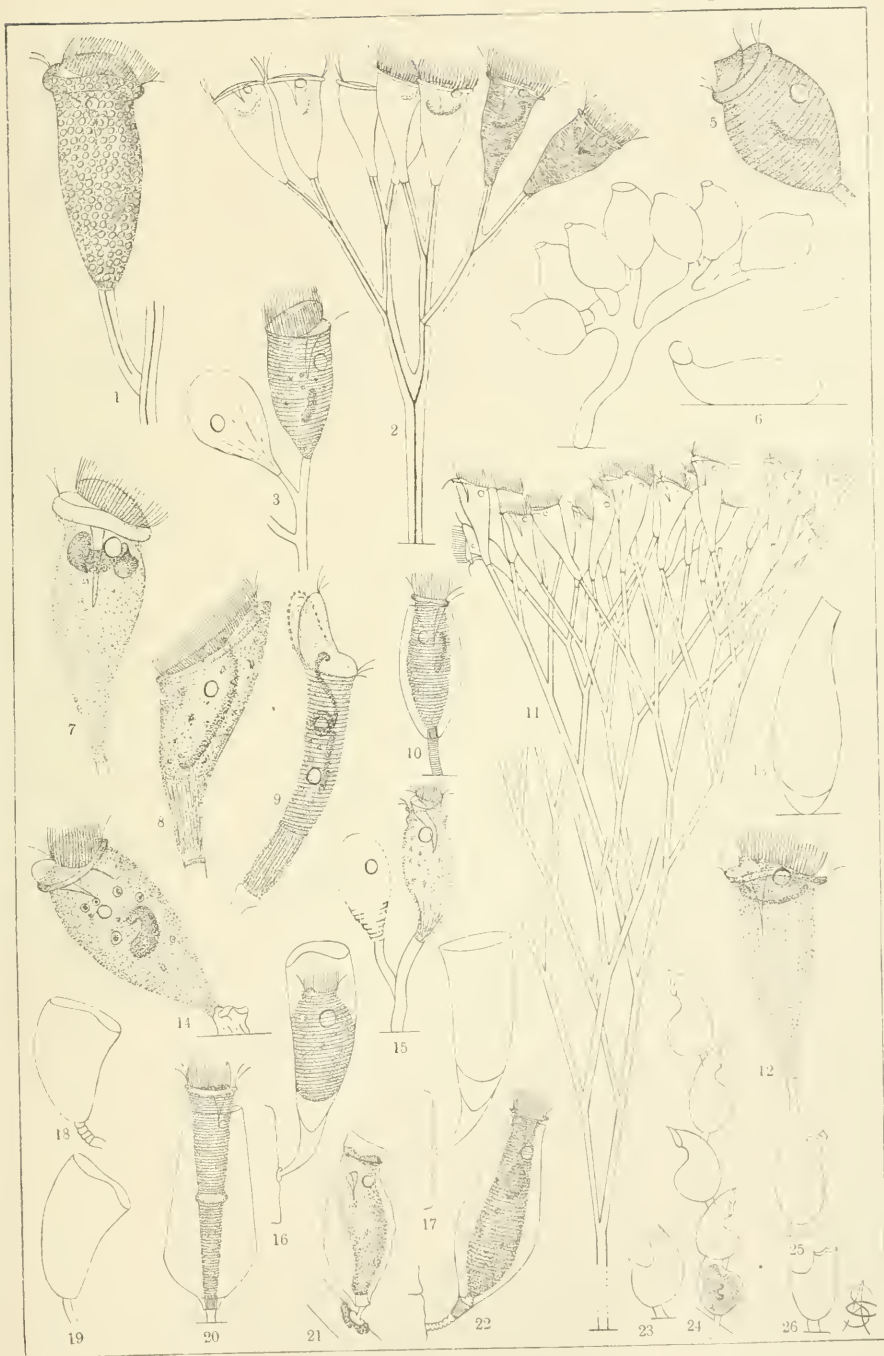


PLATE IX.

Fig.

1. Opercularia elongata. (After Kellicott), p. 247.
2. " rugosa. (After Kellicott), p. 248.
3. " " pedicle; diagram, p. 248.
4. " plicatilis; colony, p. 248.
5. " " pedicle; diagram, p. 248.
6. " " single zoöid, p. 248.
7. " Allensi, p. 250.
8. " vestita, p. 250.
9. Vaginicola leptosoma, p. 251.
10. " annulata, p. 252.
11. Thuricolopsis innixa, p. 253.
12. " Kellicottiana, p. 254.
13. Lagenophrys obovata, p. 261.
14. Litonotus trichocystus, p. 265.
15. " carinatus, p. 267.
16. " pleurosigma; ventral aspect, p. 266.
17. " " lateral aspect, p. 266.
18. " " in conjugation, p. 266.
19. " helus, p. 268.
20. " vermicularis, p. 263.
21. " vesiculosus, p. 264.

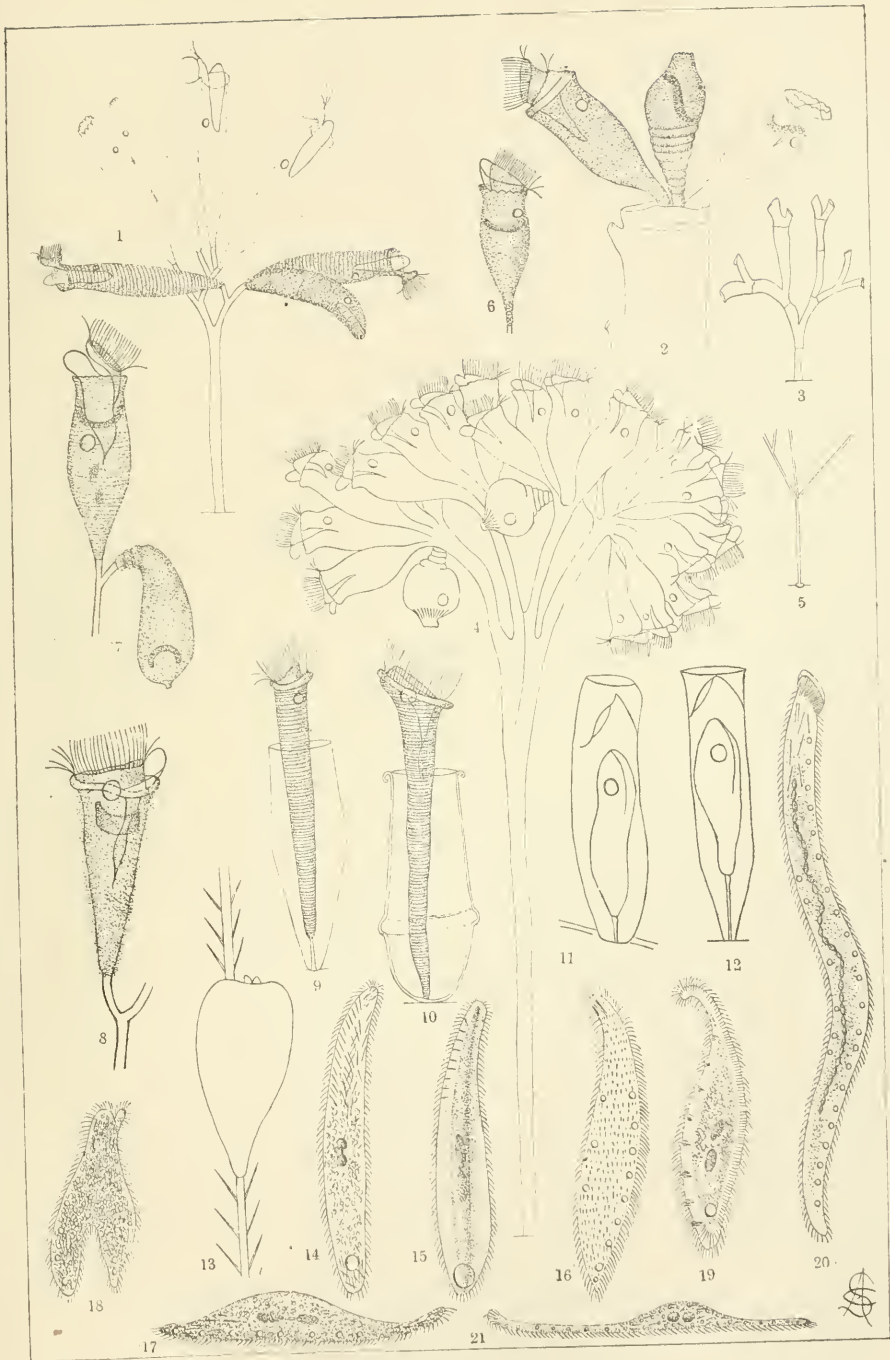


PLATE X.

Fig.

1. *Chilodon fluviatilis*, p. 269.
2. " *Megalotrochæ*; ventral aspect, p. 269.
3. " " lateral aspect, p. 269.
4. " *vorax*, p. 271.
5. " *caudatus*; dorsal aspect, p. 272.
6. " " lateral aspect of posterior region, p. 272.
7. *Loxodes vorax*, p. 273.
8. " *magnus*, p. 275.
9. *Hemicycliostyla Sphagni*, p. 276.
10. " *trichota*, p. 277.
11. *Urostyla gigas*, p. 277.
12. " *trichogaster*, p. 278.
13. *Holosticha similis*, p. 281.
14. " *caudata*, p. 282.
15. *Urostyla caudata*, p. 279.
16. *Onychodromopsis flexilis*, p. 280.
17. *Holosticha vernalis*, p. 281.



PLATE XI.

Fig.

1. *Holosticha hymenophora*, p. 282.
2. *Eschaneustyla brachytoma*, p. 283.
3. *Uroleptus limnetis*, p. 284.
4. " *Sphagni*, p. 285.
5. " *longicaudatus*, p. 286.
6. " *dispar*, p. 286.
7. " " *showing lip*, p. 286.
8. *Platytrichotus opisthobolus*, p. 287.
9. " " *posterior extremity*, p. 287.
10. *Opisthotricha emarginata*, p. 289.
11. *Oxytricha caudata*, p. 291.
12. " *hymenostoma*, p. 290.
13. " *bifaria*, p. 292.
14. " *acuminata*, p. 290.
15. *Tachysoma mirabilis*, p. 295.
16. " *parvistyla*, p. 293.
17. " *agilis*, p. 294.
18. *Histrio complanatus*, p. 296.



1



2



3



4



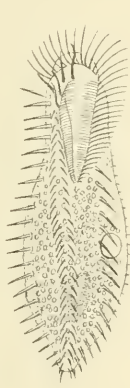
5



6



7



8



9



10



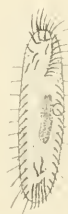
11



12



13



14



15



16



17



18

PLATE XII.

Fig.

1. *Histrio inquietus*, p. 296.
2. " *erethisticus*, p. 297.
3. *Stylonychia putrina*, p. 298.
4. " *vorax*, p. 298.
5. " *notophora*, p. 299.
6. *Euplotes variabilis*, p. 300.
7. " *plumipes*, p. 301.
8. " " ornamentation of carapace, p. 301.
9. " *carinata*; ventral aspect, p. 303.
10. " " dorsal aspect, p. 303.
11. *Trichophrya sinuosa* p. 304.
12. *Podophrya inclinata*. (After Kellicott), p. 304.
13. *Acineta urceolata*, p. 315.
14. *Podophrya flexilis*. (After Kellicott), p. 305.
15. *Solenophrya odontophora*, p. 310.

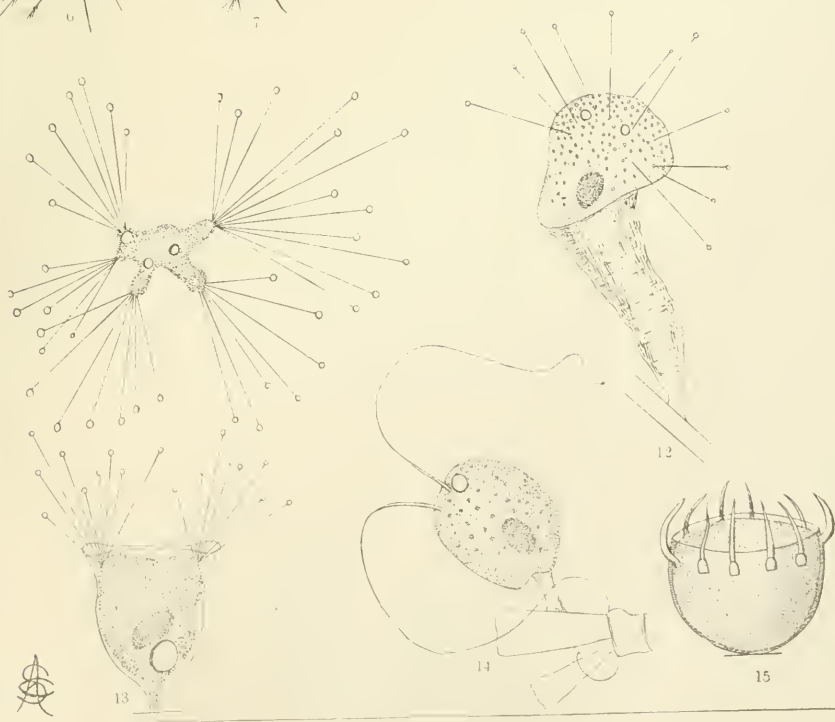
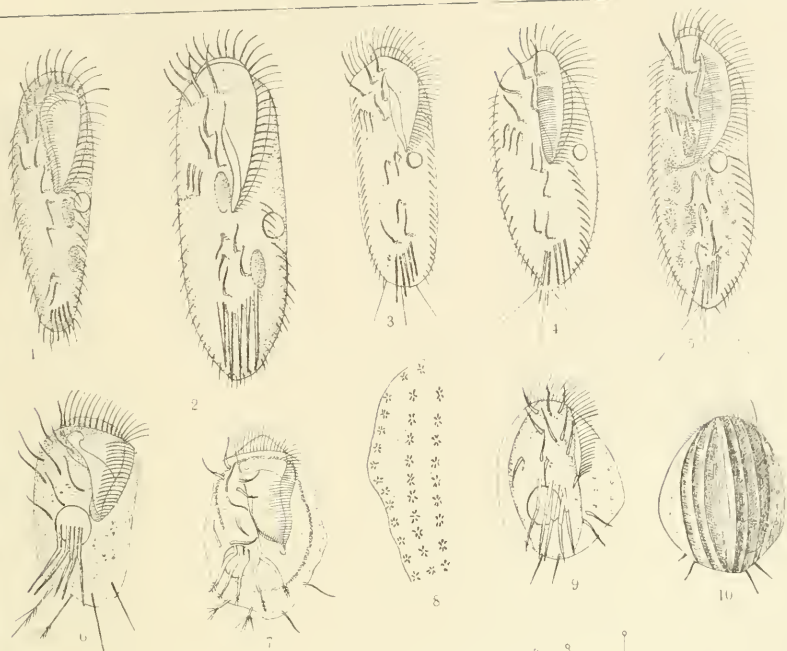
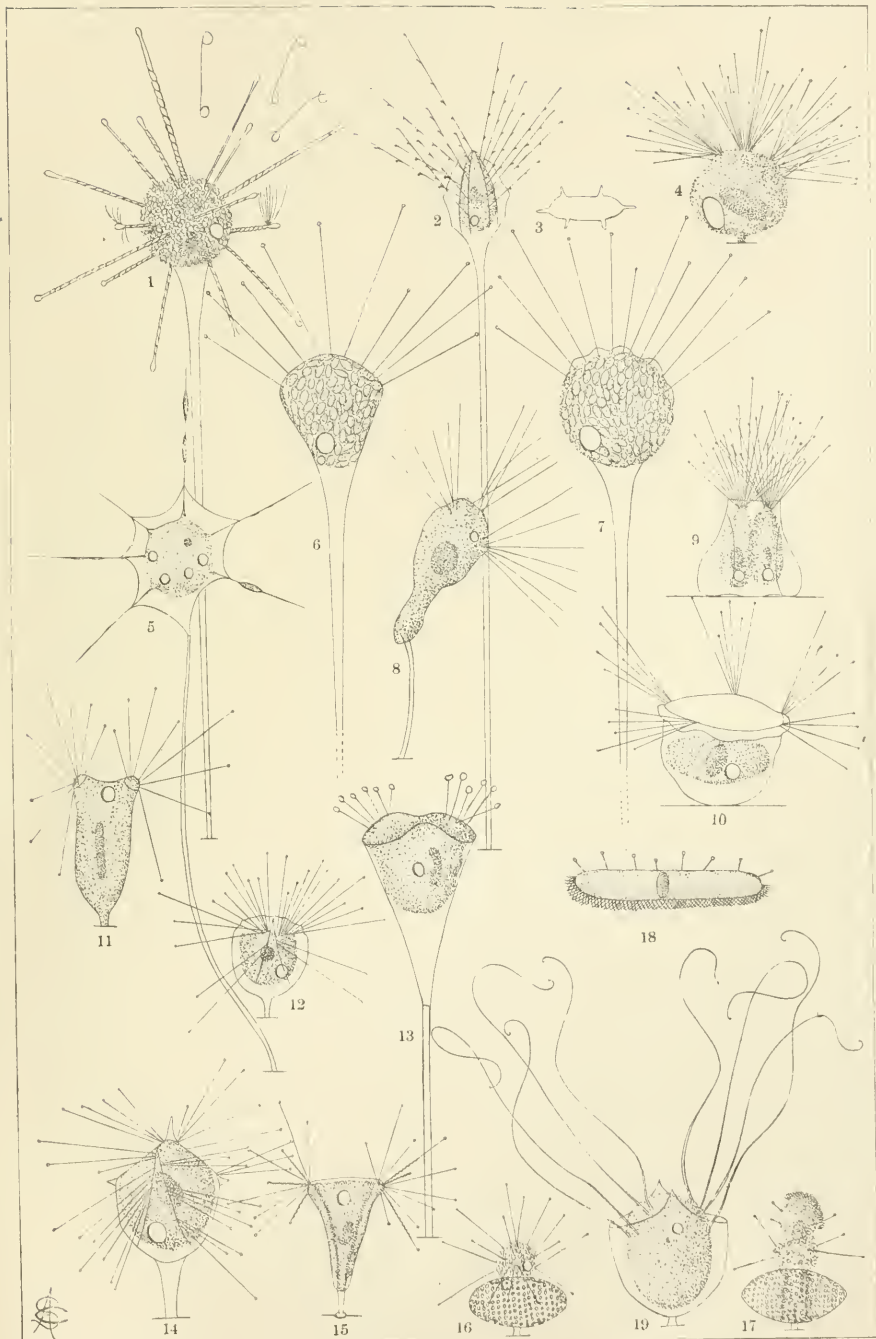


PLATE XIII.

Fig.

1. *Podophrya macrostyla*, p. 307.
2. *Acineta alata*, p. 311.
3. " " transverse optic section of lorica, p. 311.
4. *Podophrya brachypoda*, p. 305.
5. *Acineta lappacea*, p. 316.
- 6, 7. " *macrocaulis*, p. 316.
8. *Podophrya Diaptomi*. (After Kellicott), p. 307.
9. *Solenophrya pera*, p. 310.
10. " *inclusa*, p. 309.
11. *Acineta lacustris*, p. 314.
12. " *stagnatilis*, p. 315.
13. " *flava*. (After Kellicott), p. 312.
14. " *acuminata*, p. 318.
15. " *fluviatilis*, p. 312.
16. " *bifaria*, p. 317.
17. " " reproductive fission, 317.
18. " " embryo, p. 317.
19. " *cuspidata*. (After Kellicott), p. 315.



NOTES ON THE FLORA OF BERGEN COUNTY, N. J.

BY WILLARD A. STOWELL.

RARE PLANTS.

Among the rarer plants of New Jersey, collected by me in Bergen county during the past botanical season, the following are, perhaps, worthy of mention: *Asclepias verticillata*, rocks, Ramapo mountains, Darlington; *Trollius laxus*, Ramsey's; *Polygala paucifolia*, abundant, Ramsey's; *Smilacina stellata*; *Menyanthes trifoliata*; *Camptosorus rhizophyllus*; *Woodsia Ilvensis*, mountains, Darlington; *Carex platyphylla*, woods, Ramsey's, and Ramapo mountains, Darlington; *Corydalis flavula*; *Cypripedium pubescens*; *Diervilla trifida*; *Castilleja coccinea*, abundant, Ramsey's; *Arisema Dracontium*.

RAILROAD PLANTS.

There are certain weeds which seem to follow in the wake of civilization. Having been introduced into the Atlantic seaports, they advance westward as civilization extends in that direction. There are also others which spread rapidly along the lines of railroads. To the latter class belong *Cenchrus tribuloides* and *Nasturtium officinale*. *C. tribuloides*, while belonging properly to the area of the "Yellow Drift," has been disseminated at various places throughout Bergen county, along the lines of the Delaware, Susquehanna and Western railroad, and the New York, Lake Erie and Western railroad, from Jersey City to the northern limits of New Jersey. In like manner, we find *N. officinale* filling the ditches along the railroads throughout the county.

ERRORS OF LOCALITIES.

Even in standard botanical works, numerous errors in localities occur; and, while these may seem trifling to the professional

botanist, yet to the novice they are perplexing in the extreme. In Wood's "Botanist and Florist" (a most excellent book), I find *Asclepias verticillata*, "Swamps," and *Desmodium Canadense*, "Woods." While there is no doubt that they occur in such places, yet it is not always so, and the statements should be modified, so as not to be misleading. *A. verticillata* grows quite abundantly on the driest part of the summit of the mountains at Darlington; and *Desmodium Canadense* is quite as common on banks and elsewhere, as in woods. These are but examples which might be multiplied indefinitely from other works.

SECOND BLOOMING OF VIOLETS.

In the Torrey "Botanical Bulletin" of April, 1887, I mentioned the profuse blooming of violets at Ramsey's last fall, the blossoms being quite as abundant as in spring, especially those of *Viola canina*, var. *Muhlenbergii*, Gray. This year I found a number of specimens, but the blossoms were not so plentiful as last year. A specimen of *Viola pedata*, var. *bicolor*, however, which was sent me from Washington, D. C., where the var. is as common as the type, bloomed freely, both in the spring and fall.

FERNS.

The ferns of Bergen county deserve especial notice. Nearly five-sixths of all the species found in the State have been reported from this county, and several occur in no other part of New Jersey. Excepting those which grow on dry rocks, they are characterized by a luxuriance of growth foreign to the same species in Middle and South Jersey. Here, for example, may be found the larger and more divided forms of *Woodsia obtusa*, *Aspidium cristatum*, *Aspidium acrostichoides*, *Asplenium Felix-fœmina*; viz., *W. obtusa*, var. *Darlingtonii*, Stowell, *A. cristatum*, var. *Clintonianum*, *A. acrostichoides*, &c. I have collected as many as seventeen different species, besides four or five varieties, within a radius of about two hundred feet.

NOTE.—The writer has in preparation a catalogue of North American ferns,* including Mexico, Central America and the West Indies. There are many catalogues of ferns north of Mexico, but none, to my knowledge, include the whole continent of North America. I shall esteem it a great favor to receive any notes or communications in regard to the ferns of Mexico and Central America, and shall be glad to exchange botanical specimens of Eastern United States for ferns of the southwest.

222 Second St., Trenton, N. J.

NOTES ON AN INTELLIGENT PARROT.

BY DR. T. S. STEVENS.

About four years ago a friend gave me a beautiful grey African parrot (*Psittacus erythacus*). She was but a few months old when I received her, and I have found her to be not only an affectionate and tractable pet, but an interesting object of study. I have watched her with a great deal of interest, with a view of ascertaining whether her imitation, and articulation of words are purely mechanical, or whether she has any degree of intelligence as to their meaning. The parrot's memory, power of imitating sounds, and of articulating words, are really astonishing, and with it all I am satisfied there is connected a superior degree of intelligence. There are no words which she cannot be taught to articulate, and scarcely any sounds that she cannot imitate. The barking of a dog, the mewling of a cat, the crowing of a rooster, the cackling of a hen, the whistle of any bird or boy, a cough, a sneeze, the creak of a door, the street-car whistle, and all such sounds she will mimic with a startling degree of perfection. She can so closely imitate the voices of persons with whom she is familiar, in accent and inflection, that

*To be published in the next number of this Journal.

the hearer sometimes starts, expecting to see the person standing before him. She imitates my own voice and that of my wife so closely, that when about the house and out of sight of each other, we are both often deceived by her answering for us. If my wife asks me a question, or requests me to do something, Polly's "What do you say?" will often cause her to repeat the question, while her "Yes," "No," "All right," are in such perfect imitation of my voice, as to entirely mislead into the belief that I have answered her questions and received her messages; and Polly's call of my name in my wife's voice often sends me off on a fool's errand to see what is wanting.

She also possesses ventriloquial powers of no mean order. She can reproduce a distant sound just as it falls on the ear. The hooting of a distant owl, the barking of a dog in the distance, and similar sounds are reproduced with such effect that it is hard to realize that their author sits within a few feet of you. Her power of learning words and sentences is remarkable; all commonplace words that she hears about the house, she readily picks up and uses. She recognizes the milkman, the butcher's and the grocer's boys, and will give the stereotyped salutation of each with laughable mimicry and effect. She will salute you with "Good morning; how do you do; how are all the folks?" as aptly as if she knew the full import of what she is saying. She knows that "good-bye" is a parting salutation, and if she sees you with hat and gloves ready to go out, she will bid you "good-bye" as naturally as a child would. She always feels restraint at the presence of strangers, and often refuses to talk while they are in the room, but if they make a move to go, she often intrudes her "good-bye," with a promptness and energy that plainly express her desire to speed the parting guest. Her mimicry is not only in words, but in gesture as well. Her good-morning and good-bye, are accompanied with a proper inclination of the head and body. She sings, "I am going to marry Yum Yum," swaying her head and body in the most approved operatic style of the young lady

who taught it to her. The snapping of the thumb and finger with a jerking motion of the hand, she will not only imitate in the sound, but with a quick jerk of the head and neck, she will imitate the movement of the hand as well.

Little snatches of songs, as "Over the fence is out," "Over the garden wall," "Pretty Polly Hopkins, how do you do?" &c., she readily catches both in tune and words. And if you ask her to sing "Pretty Polly Hopkins," "Over the fence is out," &c., she will whistle the air before singing the words. She recognizes in the air that she whistles the tune that she sings with the words. If you repeat to her the "Bob White" of the quail, she will whistle "Bob White" in exact imitation of the bird, while, if you happen to whistle "Bob White" to her, she will, most likely, repeat the words, showing that she associates the two together. I have never tried to teach her any very long lessons, but she is an apt and attentive pupil, and will try to learn by attempting, over and over, to repeat, after me, a sentence which she is trying to master. She will get the first word, and will then keep adding word after word until she gets the whole sentence. Her mind will grasp and retain an expression or sentence, which she has heard, before she masters its articulation. A portion of the year I am in the habit of spending my Sundays in the country, and then Polly is left alone from Saturday evening until Monday morning. On going away on Saturday, I have frequently left her only able to utter a word or two of a new sentence that I had been repeating and trying to teach her. On returning Monday morning, after her "good morning" salutation, she would roll out clearly and correctly, and with evident delight at her success, the sentence that she could not master on Saturday, showing that she had learned correctly, and remembered the construction of the sentence, and was able to work out its articulation during my absence, and without assistance.

The longest lesson that I have attempted to teach her, is two verses of "Pop goes the weasel," containing forty-two words,

which she can sing correctly. No doubt I could add other verses, and she could learn to repeat them in their proper order. Here a most interesting question arises. Does she understand anything of what she says, or is it all parrot-talk? Much of her talk, no doubt, is purely mechanical imitation. In "Pop goes the weasel," of course no one will suppose that she knows the monkey from the weasel, or the priest from the cobbler's wife; or when she sings, as she often does, "Oh, what is a monkey without a tail? A dude, my mother, a dude," it is not to be supposed that she can recognize the line of demarkation between the monkey and the dude, or has any idea whatever of the meaning of what she is saying. It is all imitation. She will imitate a running conversation between two or three different persons, interspersed with exclamation and laughter. If she hears two or three ladies chatting together, she may keep silence until they have departed, and then she will begin to imitate their different voices so naturally that you might imagine they were still in the room chatting and laughing together in the most energetic manner. Of course she does not articulate the words properly, but her chatter sounds to you just as their talking and laughing would if you were just far enough away to hear the conversation without distinguishing the words. This gibberish, no doubt, conveys as much meaning to her as if she could repeat word for word the whole conversation. It is *only* an imitation of what she hears. Thus, a great portion of the articulate words that she repeats properly and in order, convey no meaning whatever to her. When she uses words and sentences appropriately, she does so, mostly, no doubt, from the force of habit and observation, by hearing such words used at certain times and under certain circumstances. She will use them at such times; the proper salutation, and many commonplace words, questions and answers heard every day in the household, she will catch up and use so naturally that you might suppose that she fully understands everything that she is saying. Usually when any one with whom she is very familiar comes in,

she will call him by name, greet him with "Good morning, how do you do; how is all the folks?" Of course she would feel just as happy if you told her that the folks were all down with the measles, as if you answered that they are all well.

Then again, she sometimes uses language that she has before learned when it accidentally happens to fit the occasion, and to this I think might be attributed some of the startling things that have been credited to parrots. On one occasion Polly looked on with interest while an old lady was paying me some money, and while it was being counted out, but just as it was handed to me, she exclaimed, "That's the way the money goes." The lady thought that the bird surely knew that she was parting with her money, while the fact is that the sight of the money had nothing to do with it. She only happened to utter at the proper time a sentence she had learned in "Pop goes the weasel." On another occasion a young lady asked Polly to sing for her. After pressing her request several times she was answered by the common excuse, "Polly has got a bad cold," accompanied with a violent fit of sneezing. The young lady was just as fully satisfied that she had the answer as an excuse for not wishing to sing as if she had given it herself, while in reality the parrot only happened to say at the right time something she had previously learned, without the least intention of making an excuse. I might note many other incidents of the same kind, when her apt words have startled strangers with surprise at her seeming intelligence and cleverness, but which in reality were only accidental coincidences.

But while I have shown that much of the language used by the parrot is purely imitative, words and sentences which she may have learned and used at random, and much which she uses properly, are so only by her observance of the proper time and circumstances, without a comprehension of the meaning, and that many of her seemingly smartest efforts are but accidental coincidences, yet I am satisfied that she is capable of acquiring and intelligently using a limited language.

There are words whose meaning she has learned to understand and to use in intelligently expressing her wishes, as a young child would. She is very fond of coffee and will say, "Polly wants some coffee," and she expects to get coffee by thus asking for it. If she sees a person pouring water or taking a drink, she will say "Polly wants a drink," and stretch out her neck expectingly and persist in asking until she gets it. Through the day she sits on an open perch with no water within her reach; at times she will ask for a drink when there is no water in sight to suggest the request, and will show by every motion of her body that she wants something, and if water or coffee is offered her you will always find her very thirsty, and will perhaps remember that it has been a long time since she has had a drink. May we not suppose that her sense of thirst suggested the words that always bring her drink?

She is in the habit of having her perch moved near the table at meal-times. If she is in the dining-room, and sees the dishes served up and the dinner ready, she will call to me "Doctor, Doctor, come to dinner." So at supper-time she will call me to supper. She knows that the noon-day meal is dinner and that the evening meal is supper, and seldom makes a mistake in the two. If you sit down to the table without moving her near it, she will soon remind you that "Polly wants her dinner, Polly is hungry," and persist until you move her to her place and give her something to eat. Sometimes when she happens to be in the office with me when the call for dinner is given, I will pretend not to hear it, and make no move to go. She will soon remind me with "Doctor, Doctor, come to dinner. Do you want your dinner? Come, Doctor, take Polly to dinner."

Nothing gives her more pleasure than to be allowed to sit a while after supper on my shoulder as I am reading, and she will be as delighted and as ready as a child to have a little romp if I will but give the signal by laying down my paper and pulling her red tail. She will retaliate by playfully pulling my hair or whiskers, or giving me a little pinch on the ear or

cheek, or by snatching my lead pencil or cigar out of my pocket, and throwing it on the floor. Then she will swing herself over, hanging out of my reach; and if I attempt to get hold of her tail or foot, she will threaten: "Polly will bite! Polly will bite!" at the same time getting hold of my finger and giving it a gentle pinch. If I pull my hand away as if hurt, and place it over my face, pretending to cry, she will try to remove it, and plead in the most tender manner, "Oh, don't cry; don't cry; kiss me; kiss me!" and when she gets my hand from my face she will give me a kiss or two on the cheek, consider everything made up, and be ready for another tilt.

If I sit down in the evening and neglect to take her, she will soon begin to coax, "Come, Doctor, take Polly; come, take Polly; Doctor, Doctor, take Polly," in such persuasive and pleading accents, at the same time stretching out her neck and wings towards me, showing by every movement her desire, so that it is hard to resist her appeals; and after having sat down of an evening to read, intending to leave her on her perch, I have been constrained to take her by reason of her persistent coaxing. I am satisfied that in asking for a drink, for coffee, for her dinner, her supper, to be taken from her perch, and for many other things, she understands the language she uses. She knows nothing about the syntax, but she knows that by using such and such verbal formulæ, she will attain certain definite ends. I have not the slightest doubt that if care were taken in teaching her the use of words by associating objects and acts with them, her acquirements in the intelligent use of language could be greatly extended.

She knows and recognizes many things by their names. She knows that the name of the big dog is Jack, and that of the little dog is Trip; and when both come near her she will call them each by his right name. Until about a year ago she had a canary bird and a robin for companions, seeming to be very fond of their company. She knew that the name of the canary was Willie, and that of the robin, Robbie. She would call to

the robin as it hopped about the room, "Robbie, you rascal, I will whip you; sing, Robbie, sing," at the same time imitating his song. If he came near her perch she would coax him in the most persuasive tones, "Come, Robbie, come; come, come, come." Her tone and manner became softer, more endearing and persuasive as he approached her, and if she succeeded in getting him near enough, she would make a grab at him with her beak, and laugh heartily as he flew frightened away. I will not say that she knew the meaning of all the words she addressed to the robin, but she knew that the name of that particular bird was Robbie, and she used her coaxing language with a clear design to cajole him within her reach, just as she had seen others call and coax him. When she looked up at the canary hanging above her perch, she never made the mistake of calling it Robbie. It was always, "Heigho, Willie! poor little Willie; sing, Willie." She also recognizes and calls by name at least a dozen persons whom she is in the habit of seeing often. If any one whom she thus knows comes where she is, she will almost invariably salute him by name. She will often recognize her friends by their voices and call them by name before she sees them. Her memory is most tenacious, and I believe that very little of what she has once learned ever slips entirely from her recollection. I have often been surprised at hearing her repeat things that I had entirely forgotten that she knew, things that she had not repeated and that had not been repeated in her hearing for months. She seems to recollect and recall things of the past by the same mental process that a human being would use, and by the association of ideas. The summer months she spends in the country, and when there she will soon learn the names of the men, the boys and the dogs about the farm. She will call and scold the chickens and ducks, drive the horses and the cows, squeal like the pigs, cackle like the hens and crow like the roosters. When she returns to town she will in a few days drop all this, and take up the talk that she has been used to at home. If, in

a week or two, or a month, it may be, some one whom she knows comes in from the country, the sight of him recalls to her mind the country and its associations, and for the remainder of the day the household will be entertained by all the noises, sounds and calls that she learned in the country, as one after another she recalls and repeats them, thus showing that one thing will suggest to her mind other things associated with it. During the political campaign of 1884, I taught her to say "Polly's a Republican," and to "Hurrah for Blaine and Logan!" and when a parade was passing I would place her near the window, where she would lustily hurrah for Blaine and Logan. After the campaign she gradually laid her politics aside, but she ever afterwards associated her Republicanism with martial music, for often, even now, when a band of music passes, she will begin: "Polly's a Republican. Hurrah for Blaine and Logan!"

She also has a good memory of persons. Those to whom she takes a particular liking and whom she allows to pet and fondle her, even though their acquaintance be short, she will recognize months after, with manifest pleasure and a desire to receive their attentions. While in the country this summer, a child of whom she is very fond, but whom she had not seen for months, went up to her cage. She at once greeted him, by name, with every evidence of delight. This winter I replaced the canary, lost more than a year ago, with another. My wife called it Robbie, because we had been unfortunate with Willies. The parrot took up the name Robbie, and soon commenced to talk to it as she used to do to the robin, calling it a "little rascal," and importuning it to sing, and threatening to whip it if it did not, the name of Robbie recalling all the language she had formerly used to the robin. We purposely did not mention the name of Willie to her, so as to learn if the sight of the bird would recall the name of the lost canary. This morning she looked up at it in its cage and greeted it with "Heigho, Willie,

poor little Willie!" The sight of the canary had recalled to her mind the little Willie of more than a year ago.

From these observations, it must be admitted that the intelligence, powers of observation and tenacity of memory in these birds, at least in this one, must be of the highest order.

If, in these notes, I have erred in the standard of intelligence that I have ascribed to this parrot in the use of language, it has been that I have not credited her with the full measure that she deserves.

DO SNAKES CHARM?

BY FRED. A. LUCAS.

Ignorance is the parent of superstition. Superstition is the great barrier in the way of truth's advancement. Early-inculcated errors take such strong hold on the human mind as to almost defy eradication. The animate and the inanimate objects of nature, a true knowledge of which is confined to a comparative few, are usually enveloped in superstitious fallacies in the minds of the great mass of humanity. Early-instilled fear of certain objects in nature, or strong prejudices, establish fallacious opinions of the real character of such offensive things.

The above-stated verities apply with significant pertinency to the prevailing sentiments so strongly derogatory to the true character of that universally despised class of animals, scientifically titled reptiles. Of this great class the members that elicit expressions of special detestation, are found in the Order Ophidia, commonly known as snakes.

Authentic knowledge of the true character and the natural habits of these creatures, is limited to a small number of students of the life history of the snake family; and even these supposedly reliable sources of scientific information relative to snake life, are so contradictory in some of the statements given

by them as facts, as to confuse the mind of one anxious to learn the truth of the matter.

The great majority of the human family, civilized and barbaric, learned and illiterate, accept without doubt, the prevalent belief that snakes in general are endowed with a peculiar mesmeric power, by the exercise of which they stupefy their prey, thus insuring an easy capture. The most absurd and unreasonable instances of "snake-charming" are accepted and cherished as evidences of the terrorizing potency of the snake's power over man and beast.

Innumerable cases of the manifestation of this ability, on the part of the snake, to overcome its victim may be readily obtained by questioning persons relative to the matter; but in nearly every instance the informant refers the questioner to a third party, that either saw the act or experienced the spell; seldom can be found the person that can give an intelligent, coherent account of his own experience of the snake's power to charm. Generally, when an apparently reliable case is secured, a close investigation of the incident results in proving that the victim was paralyzed with fear, rather than made powerless by mesmeric influence.

In nearly every human mind a strong sentiment of excessive repugnance if not actual horror of the members of the snake family finds lodgment. Strong men, as well as delicate, sensitive women, turn pale and are overcome with intense nervous perturbation when even the smallest of snakes touch their persons. Herein lies the whole secret of the prevalent error regarding the snake's potent influence.

Man and the lower creatures entertain such fear of the despised ophidian that when unexpectedly meeting one of these horrid animals they are in the proper condition to be peculiarly affected by the fascinating gracefulness and the general appearance of satanic cruelty so natural to the snake. The degree of stupefying influence thus exerted by the snake depends largely

on the nervous sensitiveness or the natural timidity of the subject.

So strong is the inherent feeling of repulsion toward the snake so universally found in man, and its kindred feeling, an instinctive dread, seated in the lower animals, that instances are given wherein the animal so influenced becomes a powerless and easy victim to the capacious maw of its relentless captor, while cases are presented where even members of the human family have been so overcome as to require assistance to release them from their unpleasant position. In all such cases the explanation lies in the excessive fear or horror of the victim, and it cannot possibly be found in an endowed power of the snake to charm.

Thus, to conclude, it must be accepted as a scientific verity, that the power to charm, so universally granted to the snake, does not exist, but rather, in accordance with the heaven-pro-nounced curse on the snake, animate nature, in its highest and most sensitive forms, entertains such strong feelings of fear and repulsion toward this animal, as to suffer temporary paralysis when meeting it.

As a noted naturalist truly declares: "Whether they be alive or dead, they convey a repulsive feeling to the mind, which is not felt on examining any other animal."

ERRATA.

Page 28, 12th line from bottom, for "*Taphrosoma*," read *Taphrocampa*.

Page 28, insert: *o*. Brain conspicuous, 3-lobed; eye single; tail a minute tubercle. *Copeus*, 33.

Page 29, 10th line from bottom, for "*v*. Lorica subspherical, gaping behind," read *v*. Lorica subspherical or pyriform, ventral aspect split.

Page 30, 3d line from bottom, for "*trieobata*," read *trilobata*.

Page 31, 4th line from bottom, for "*annulata*," read *annulatus*.

Page 35, add to genus 33, *Copeus*: Lumbar organs wholly wanting. *Cerberus*.

Page 39, add to genus 45, *Diaschiza*: *b*. Toes blade-like, recurved; *pata*.

Page 49, 2d line from top, for "*candatus*," read *caudatus*.

Page 65, 9th line from top, for "tentacles 6," read tentacles 16.

Page 66, after Fig. 19, insert: Fig. 20. *Norodonia Sinensis*. Single cells.

Page 66, 2d line from bottom, for "Fig. 20. *Histopia lacustris*," read Fig. 21.

Page 66, 2d line from top, for "tentacles 6," read tentacles 16. (?)

OFFICERS FOR 1888-9.

PRESIDENT,

DR. T. S. STEVENS.

TREASURER,

PROF. AUSTIN C. APGAR.

SECRETARY,

FRED. A. LUCAS.

CORRESPONDING SECRETARY,

PROF. O. P. STEVES.

MEMBERS.

A. D. ANDERSON.
PROF. A. C. APGAR.
E. A. APGAR.
DR. F. V. CANTWELL.
S. W. COCHRAN.
HON. W. CREVELING.
EDMUND C. HILL.
WM. S. LEE.
J. S. LOWNIE.

F. A. LUCAS.
PROF. W. MACFARLAND.
DR. P. MCGILL.
ALBERT MORSE.
J. C. OWENS.
GEORGE PINE.
W. A. POLAND.
W. A. SMITH.

DR. T. S. STEVENS.
PROF. O. P. STEVES.
DR. A. C. STOKES.
GEN. W. S. STRYKER.
W. A. STOWELL.
ERNST VOLK.
DR. H. G. WETHERILL.
EDMUND WOOD.

CONTRIBUTORS.

HON. E. J. ANDERSON.
J. S. AITKIN.
HON. J. H. BLACKWELL.
DR. J. L. BODINE.
JOHN G. BOX.
HON. J. H. BREWER.
CAPT. F. O. BRIGGS.
ALBERT CLAYTON.
H. U. COLEMAN.
E. G. COOK.
DR. ISAAC COOPER.
A. M. CROOK.
P. W. CROZER.
HON. W. L. DAYTON.
DR. CHAS. DIPPOLT.
B. L. DISBROW.
E. B. DOLTON.
HON. R. A. DONNELLY.
DR. C. H. DUNHAM.
S. P. DUNHAM.
ALEX. DUNN.
DR. W. ELMER.
E. W. EVANS.

CLARK FISHER.
E. T. GREEN.
BARKER GUMMERE.
BARKER GUMMERE, JR.
H. H. HAMILL.
L. I. HANNUM.
T. C. HILL.
ISRAEL HOWELL.
T. W. JOHNSON.
HON. H. C. KELSEY.
J. Y. LANNING.
A. LAWSHE.
HON. B. F. LEE.
W. H. LINBURG.
O. H. LOCKE.
F. C. LOWTHORP, JR.
G. W. MACPHERSON.
HON. F. A. MAGOWAN.
H. A. MARTINDELL.
F. S. McNEELY.
DR. D. N. MERRILL.
W. S. MIDDLETON.

ECKFORD MOORE.
RANDOLPH H. MOORE.
ELIJAH MOUNTFORD.
JOHN L. MURPHY.
HON. LEWIS PARKER.
B. M. PHILLIPS.
DR. W. W. L. PHILLIPS.
DR. L. E. READING.
E. V. RICHARDS.
I. F. RICHEY.
DR. H. SCHAEFER.
W. H. SKIRM.
W. W. STELLE.
E. B. STERLING.
HON. JOHN TAYLOR.
T. B. TAYLOR.
W. I. VANNES.
HON. G. D. W. VROOM.
G. R. WHITTAKER.
EDMUND WOOD.
HON. R. S. WOODRUFF.
F. B. YARD.

CORRESPONDENTS.

J. H. BRAKELEY, PH.D.
S. LOCKWOOD, PH.D.

GEO. MACLOSKIE, LL D.
J. H. BUTTERFOSS.

INDEX.

A.

	PAGE
Acineta	312
Acinetidae	304
Acinetactis.....	74
Actinomonas.....	72
Actinnrus	27, 33
Acyelus	27, 31
Adineta..	27, 33
Albertia	28, 34
Amblyophis	86
Amphileptus	167
Anisonema..	106
Anisonemidae	106
Anoplophrya	185
Anuræa	29, 42
Anthophysa	83
Apgar, A. C.....	6, 58
Apgar, E. A.....	43
Apgaria	194
Apsilus	27, 31
Aspidisca	300
Asplanchna	28, 33
Astasia	101
Astasiidae	101
Asthmatos.....	144
Atractonema	92
Attacus cynthia, Double Cocoons of	13

B.

Balanitozoön	212
Bergen county, N. J., Flora of....	345
Bikæcidæ.....	75
Bodo	103
Bodonidae.....	103
Bone Reconstruction, Case of.....	52
Bothrostoma.....	198

PAGE

Brachionus	30, 42
Bursaria.....	186
Bursariidæ	186

C.

Calceolidæ	209
Calceolus	209
Callidina	27, 33
Calypotricha	182
Calypotrichidæ	180
Carchesium	240
Cathypna	30, 40
Cephalosiphon	27, 31
Cephalothamnium.....	83
Ceratium.....	144
Cercomonadidæ.....	75
Chilodon.....	21, 269
Chilomonas.....	122
Chlamyodontidæ.....	269
Chloromonas	85
Chloropeltis	91
Choano-Flagellata.....	126
Chrysomonadidæ	113
Chrysomonas.....	87
Chrysopyxis	113
Cicada septendecem.....	43
Ciliata	147
Cilio-Flagellata	144
Cladonema	83
Clostenema	111
Cochleare.....	29, 41
Codosiga	128
Codonosigidæ	126
Cœlomonadidæ	85
Cœlopus	29, 38
Colepidæ.....	156
Coleps	156

	PAGE
Colpidium	176
Colpoda	157
Colurus	29, 40
Conochilus.....	26, 32
Copeus	28, 35
Cothurnia	255
Cristatella	62, 64
Cryptoglena	85
Cryptomonadidae	122
Cryptomonas	125
Ctedoctema.....	187
Cyclanura	89
Cyclidium.....	183
Cyclonexis	117
Cyrtolophosis.....	193
Cyrtolophosiidae.....	192
Cynthia, Double Cocoons of.....	13

D.

Dallasia	171
Dendrocometes.....	319
Dendrocomitidae	319
Dendromonas	83
Dendrosoma	319
Dendrosomidae	319
Derepyxis	115
Desmarella	135
Dexiotricha.....	21, 151
Diaschiza	30, 39
Diglena	29, 36
Dinenympha	184
Dinifera.....	141
Dinobryon	84
Dinocharis.....	30, 38
Dino-Flagellata	141
Diplax	30, 39
Diplois	30, 39
Diplomastax	171
Diplomestoma.....	171
Diplospyla.....	182
Distemma	29, 37
Distyla	30, 40

E.

	PAGE
Enchelyidae	156
Entosiphon.....	108
Eosphora.....	28, 36
Epipyxis	84
Epistylis	241
Eretmia	29, 43
Errata	359
Eschaneustyla	283
Euchlanis	30, 39
Euglena	86
Euglenidae	86
Euglenoidea	85
Euplotes	300
Euplotidae	300
Exechlyga	119

F.

Fishes, Binocular Vision in Lat- eral-eyed.....	6
Flagellata	71
Flora of Bergen county, N. J., Notes on	345
Floscularia	29, 36
Flowers under Cultivation, Wild.....	9, 46
Fredericella	61, 63
Furcularia	29, 36

G.

Gerda	214
Glaucoma	300
Goniomonas	83
Gyrocoridae.....	212
Gyrocorus	212

H.

Halteria	209
Halteriidae	209
Hemicycliostyla	276
Heteromastax	144
Heteromastigidae	144
Heteromastigoda	103
Heteromita.....	103

	PAGE
Heteromonadidae	81
Heteronema	104
Heterotricha	186
Hexamita	121
Hibernation of Reptiles.....	14
Hislopia.	61, 65
Histiobalantium.....	177
Histrio	296
Holophrya.....	150
Holosticha	281
Holotricha.....	147
Humming-Bird, Nesting Habits of	55
Hyalinella.	62, 63
Hydatina	28, 34
Hymenostoma.....	173
Hypotricha	263

I.

Ileonema.....	142, 145
Infusoria, Fresh-water.....	71
Infusoria, Peridinium and other..	18
Isomastigoda.....	113

K.

Kerona	276
--------------	-----

L.

Lacinularia	27, 32
Lacrymaria.	164
Lagenophrys	260
Laguncula.	21, 88
Lagynus.....	166
Lee, W. S.....	8
Leucophrys	200
Limnias	27, 31
Litonotidae.....	263
Litonotus.	263
Lophopus.....	62, 64
Loxodes	20, 273
Loxophyllum.....	168
Lucas, F. A.	14, 356

M.

	PAGE
Macfarland, Wm.....	1, 55
Mallomonadidae.....	92
Mallomonas.	92
Mastigamœba	72
Mastigocerca	29, 37
Megalotrocha.....	27, 32
Melicerta	27, 31
Menoididae	92
Menoidium.....	92
Mesadinium	211
Metopides	186
Metopidia.	29, 41
Metopus	186
Microcodon... ..	28, 33
Monadidea	71
Monosiga	126
Monostyla.....	30, 40
Monura	29, 41
Muskrat and the Unio.....	58
Muskrat Opens the Unio, How the	8
Mytilia	29, 41

N.

Norodonia.....	61, 65
Noteus	30, 42
Notholca.....	29, 42
Notommata.....	28, 34
Notonecta an Enemy of the Gold- Fish.....	11
Notops	28, 34
Notosolenidae.....	108
Notosolenus.....	108
Nyctotherus	186

O.

Œcistes	27, 32
Oikomonas	75
Onychodromopsis	280
Opalina	184
Opalinidae.....	184

P.

R.52.

Sacculus	28, 33
Salpina	30, 39
Salpingœca	137
Salpingœcidae	137
Saprophilus	181
Scaridium	30, 38
Scyphidia	215
Snakes Charm ? Do.....	356
Solenophrya	309
Solenotus	109, 111
Sphaerophrya	304
Spirochona	217

	PAGE
Spirostomidae	194
Spirostomum	20, 199
Spongomonadidae	113
Spongomonas	113
Spumella	84
Stephanoceros	27, 31
Stephanomonadidae	144
Stephanops	30, 38
Stevens, T. S.	11, 347
Stichotricha	21, 283
Stentor	203
Stentoridae	203
Stokes, A. C.	18, 71
Strombidinopsis	207
Strombidium	209
Stowell, W. A.	16, 23, 345
Stylobryon	79
Stylohedra	262
Stylonychia	21, 298
Suctorina	304
Syncheta	28, 33
Synura	117

T.

Tachysoma	293
Taphrocampa	28, 34
Tentaculifera	304
Tetramitidae	118
Tetramitus	118
Tetraselmis	118
Thuricola	253
Thuricolopsis	253
Thyridopteryx ephemeræformis..	1
Tillina	158
Tintinnidae	207
Tintinnidium	207
Tracheliidae	167
Trachelius	167
Trachelocerca	164
Trachelocercidae	164
Trachelomonas	21, 87
Trachelophyllidae	153

	PAGE
Trachelophyllum	153
Trentonia	125
Triarthra	28, 34
Trichodina	214
Trichonemidae	145
Trichonympha	184
Trichonymphidae	184
Trichophrya	304

U.

Unio, How the Muskrat Opens the	8
Unio, The Muskrat and the.....	58
Urceolaria	214
Urceolariidae	214
Urceolopsis	94
Urceolus	93
Urnatella	61, 62
Urocentrum	214
Uroleptus	284
Uronema	183
Urostyle	277
Urotricha	156
Uvella	117

V.

Vaginicola	251
Vaginicolina	251
Volk, Ernst.	9, 46
Vorticella	20, 223
Vorticellæ, Key to Species.....	224
Vorticellidae	214
Viola palmata, Varieties of.....	23
Vision of Lateral-eyed Fishes, Binocular.....	6

W.

Wetherill, H. G.	52
Woodsia obtusa, Varieties of.....	23

Z.

Zoöthamnium	240
Zygoselmis	102

